DESIGN, CONSTRUCTION, OPERATION OF METAL-WORKING AND ALLIED EQUIPMENT

MACHINERY

DECEMBER, 1941

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DEPARTMENTS

Continuing the series of articles dealing with the production of munitions and equipment for the United States Army and Navy, the January number of MACHINERY will contain important information on war material manufacture. Other articles of importance at the present time will deal with *Adequate Lighting in Industrial Plants; How to Obtain Longer Life from Broaches; and Heat-treatment of Molybdenum Steels.*

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Without blare of trumpet—in fact, without audience, except a few members of the coast guard stationed at Kitty Hawk—the Wrights made their first flight with a power-driven machine.

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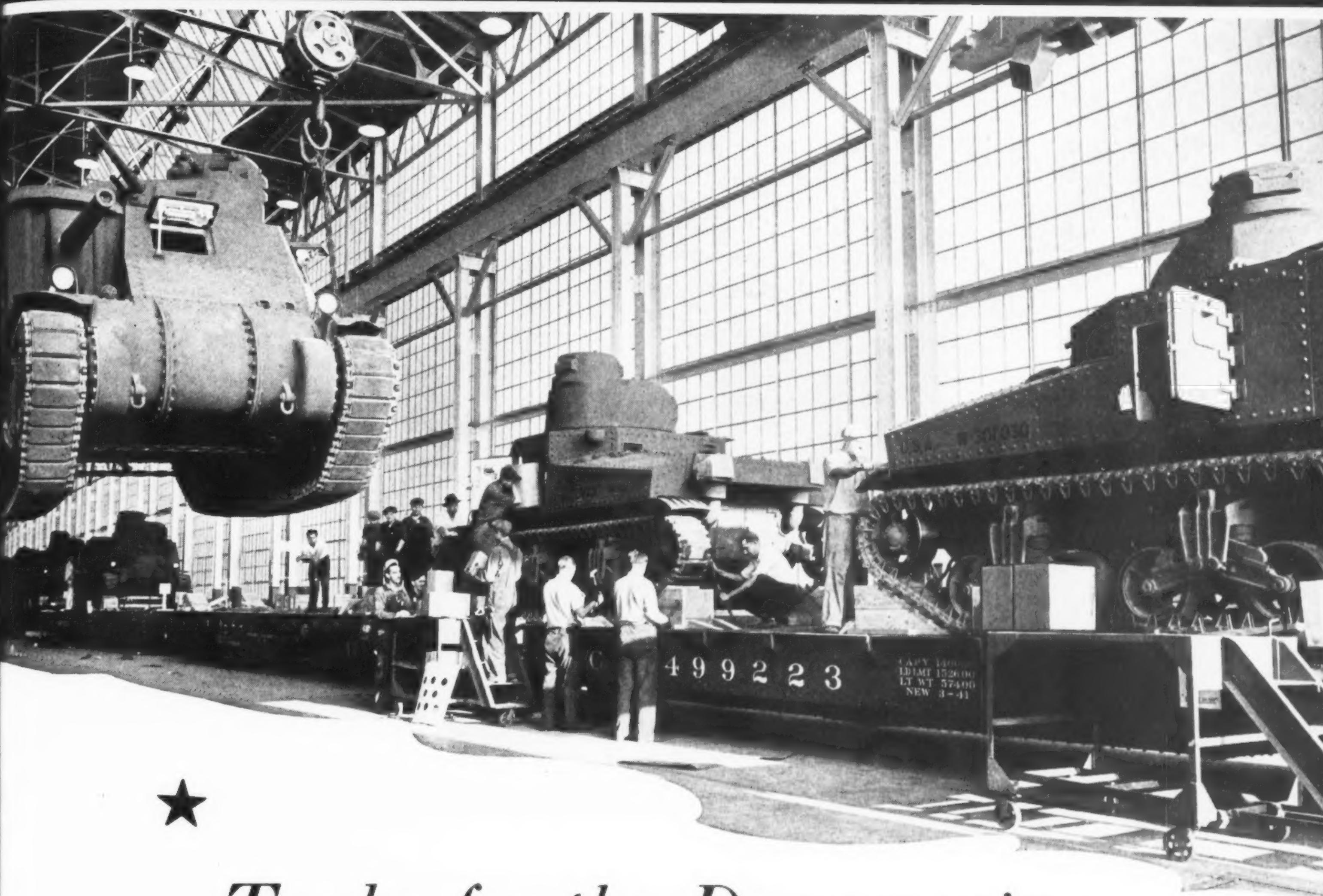

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Tanks for the Democracies Roll from Chrysler's Arsenal

By CHARLES O. HERB

WHEN the present national emergency is past history and the American public has time to reflect dispassionately upon the events now occurring, high praise is certain to be given to industry for some of the miracles it has achieved during this trying period. One such accomplishment, which is indicative of the speed with which plants are springing up around the country for the manufacture of war products, is the tank arsenal built and operated by the Chrysler Corporation for the United States Army. A corn field on the outskirts of Detroit one year ago—today a manufacturing plant five city blocks long by two city blocks wide (comprising an area of 700,000 square feet) devoted exclusively to the production of 28-ton M-3 medium military tanks. It is believed that this is the largest arsenal in the world completely devoted to the production of military tanks. The first tank was delivered from this plant to

Army officials within five months from the date that the erection of steel for the building was started. Today tanks in various stages of completion roll continuously down three assembly lines.

More than one thousand machine tools of standard and special designs were installed in this plant and equipped with jigs, fixtures, and tools that had to be originated from drawings of the tank details. The erection and equipping of the arsenal were accomplished in a record time that constitutes a testimonial to the ability and cooperative spirit of the Army officials and Chrysler executives in charge of developing the arsenal, the constructors of the building, the machine tool manufacturers, the tool designers and suppliers, and all others who had part in the speedy completion of the plant.

Before describing some of the outstanding operations in this tank arsenal, a few comments will be made concerning its product. The M-3 medium tank, illustrated in Fig. 2, is the largest American tank now in production, although larger tanks are contemplated. This tank, however, has as heavy firing power as any tank which has run roughshod over the battlefields of Europe, if not heavier. It is equipped with a 75-millimeter gun that has a firing range of 15,000 yards. Guns of this caliber were used as anti-tank weapons in the Battle of France, but in the form of field artillery they were not sufficiently mobile to do the damage that they can accomplish when mounted on M-3 tanks.

In addition, these tanks are equipped with an anti-aircraft gun that can also be fired point blank, and four machine guns. Also, the normal crew of seven men will have a stackful of submachine guns which are fired out of portholes in close-range operations, as against infantry. The tank weighs approximately 28 tons, has an over-all length of 18 feet, and a height of more than 8 feet. It is equipped with an upper revolving turret. The rated speed is 25 miles an hour, but the tanks can travel at somewhat higher speed on smooth terrain. They are driven by a powerful air-cooled aircraft engine, which is mounted in the rear.

The Chrysler tank plant was laid out for minimum handling of raw materials and work

in process. A railroad track extends the full length of the building on one side, and there is storage space along this track for supplies. The track and storage space are in a bay 60 feet wide, which is served by several overhead cranes. Bays 60 and 30 feet wide equipped with machine tools extend across the shop from the receiving and storage bay to an 80-foot bay that runs the entire length of the building on the opposite side. This large bay contains some of the largest machine tools and also the three assembly lines. It is served by large-capacity overhead cranes, and there are cranes as well in the feeder lines of machine tools which run crosswise of the building. No operator need lift heavy parts by hand into the machines. A general view of the large bay taken from the ends of the assembly lines is shown in Fig. 1. The heading illustration shows tanks being loaded on flat cars after they have been fully assembled and then tested on the proving grounds adjacent to the plant.

Similar to the lines of machine tools, there are sub-assembly lines extending from the incoming railway track on one side of the shop to the assembly lines that run parallel along the opposite side of the building. In these sub-assembly lines, units of armor and other steel plates are assembled, ready to be transferred to the final assembly lines.

At the beginning of each final assembly line the floor-plate section of the tank is lowered by a crane on an assembly "buck." After a number of additional plates have been assembled, the partially assembled tank is lifted by a crane to the next buck, and this procedure is repeated until the bogie wheels have been added, after which the tanks roll along the assembly lines on their own wheels until the shoe tracks or "caterpillar tread" are assembled near the ends of the lines. The engine, gun mechanisms, and most of the actual operating mechanism are installed after the wheels have been assembled.

More than 1900 rivets of alloy steel must be driven in the sub-assembly and final assembly of the tanks. All rivets are squeezed cold, with the exception of those that must be driven in locations inaccessible to the large-squeeze riveters. Rivets in such locations are driven hot by the use of small riveters of the pneumatic type. Along the sub-assembly lines the rivets are driven principally by huge stationary pneumatically operated machines, installed with the anvil and ram positioned horizontally, about 7 feet above the floor, thus allowing for the convenient handling of large plates. Along the final assembly lines the rivets are squeezed by the application of huge portable pneumatic squeeze riveters of the type shown in Fig. 3. These riveters are rated at a capacity of 125 tons. There are nine of these portable riveters along the assembly lines.

Contrary to popular belief, the manufacture of tanks calls for the application of many machining methods that differ considerably from those employed in the production of automobiles and motor trucks. This is due to the fact that the body of the tank is made from heavy armor plates and castings, and the turret and other parts are of such dimensions that they must be machined on boring mills, radial drilling ma-

Fig. 1. Military Tanks Roll down Three Assembly Lines in the Chrysler Arsenal. They Reach the Ends Painted and Fully Equipped for Tryouts on the Adjacent Proving Grounds

Fig. 2. One of the M-3 Medium 28-ton Tanks Built in the Arsenal Operated by the Chrysler Corporation for the U. S. War Department

chines, milling machines, etc., of much larger size than ordinarily found in automobile plants. The turret casting alone is as heavy as the average automobile. The toughness of the armor castings and forgings necessitates the use of tungsten-carbide tools in nearly all turning and boring operations, and cutters of high-speed steel containing a high cobalt content in milling and similar operations. Some of the outstanding operations involved in machining tank parts in this plant are described in this article.

A considerable number of Hydrotel milling machines have been installed in this plant, both for contour milling operations and for ordinary face-milling of large parts. In contour milling operations, the cutter travels around irregular-shaped surfaces under the guidance of an electrical device, which automatically follows the outline of a templet, as seen in Fig. 5. In this operation, the cutter is applied for milling round corners of the front turret plate, the templet being seen at the right. The tracer of the electrical control consists of a cylinder of the same diameter as the cutter.

Four bearing pads with two shoulders each are also milled in this operation. Prior to taking each of these cuts, the cutter is positioned at the required height by means of a gage-block that is permanently attached to the left-hand end of the templet. Feeler gages are used be-

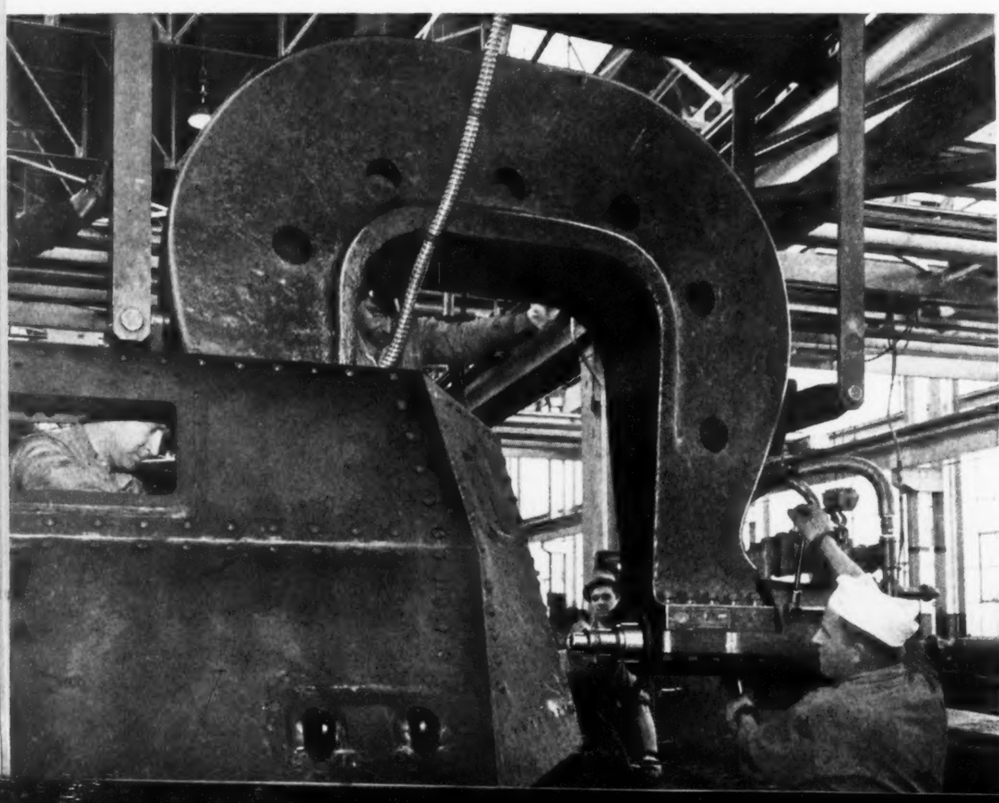


Fig. 3. Along the Tank Assembly Lines Rivets are Squeezed Cold by Huge Portable Riveters of 125 Tons Rating

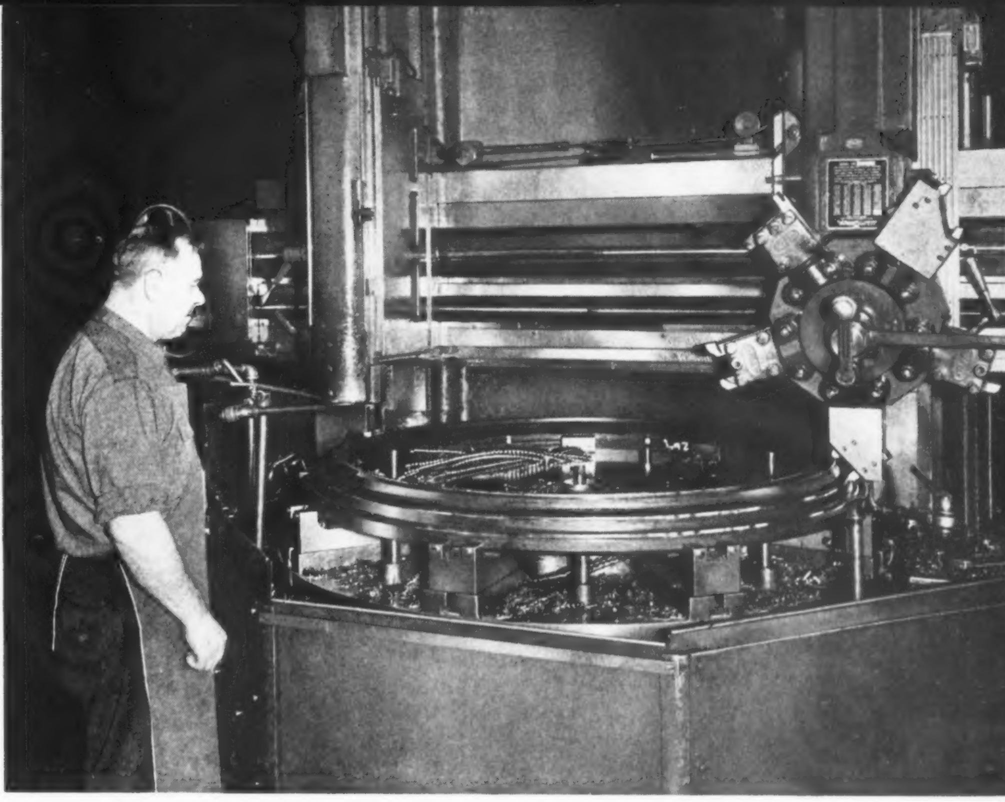


Fig. 4. Vertical Turret Lathes are Employed in Machining Turret Rings to the Close Limits of Accuracy Required by Army Specifications

tween the various surfaces of this block and the end of the cutter. There is a similar block attached to the front of the fixture for locating the cutter at the required height for machining the face of the flange.

Typical of some of the heavier jobs is the operation illustrated in Fig. 6, which shows an 84-inch vertical boring mill engaged in taking a series of turning, boring, and facing cuts on the bottom of a turret casting of armor steel. The tungsten-carbide tool bits used in this operation are mounted on 1 1/4-inch square shanks. All together, cutters of eighteen different shapes are employed for machining the various angular surfaces, a groove, a rounded edge, and so on. On the maximum turned diameter of more than 5 feet, the tolerance is 0.010 inch.

Another operation that calls for high-grade workmanship is the machining of the turret rings. These parts are made from steel forgings having a high nickel content. Fig. 4 shows such an operation being performed on a vertical turret lathe. Tools on both the turret and ram are used, a total of thirteen cutters being required for the various turning and facing cuts taken on the side of the rings that is seen uppermost in the illustration. The other side of the rings is also machined on a vertical turret lathe. Most of the turret stations on this machine are provided with tools for taking two cuts simultan-

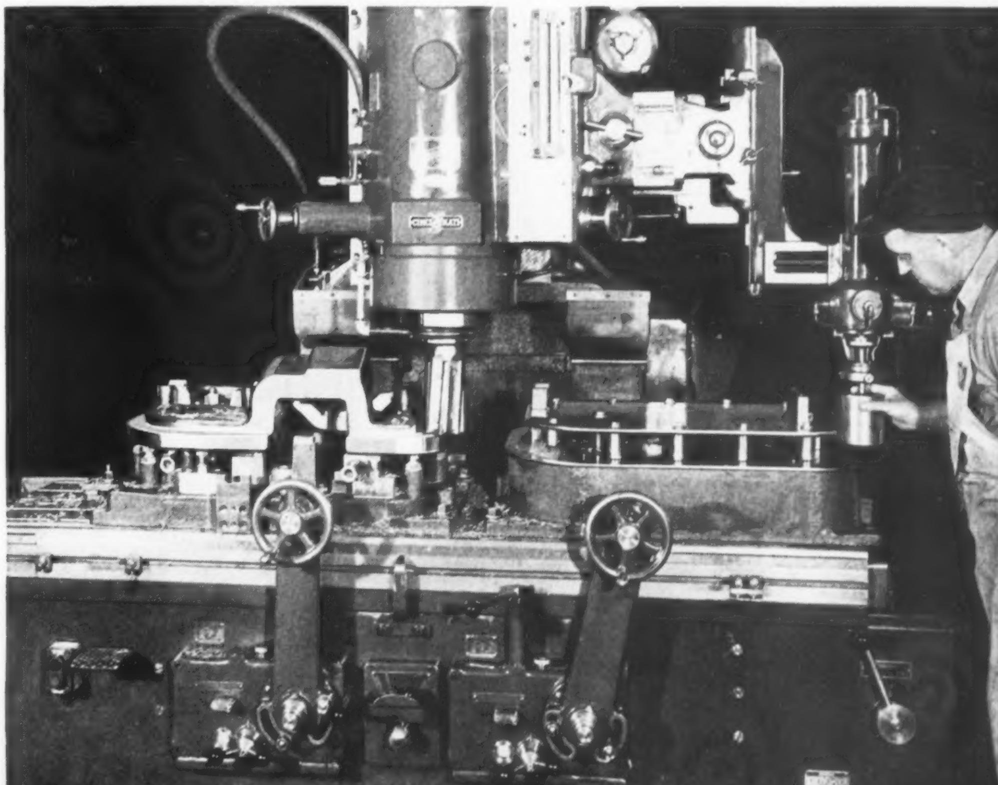


Fig. 5. Contour Milling Operation in which the Cutter Movements are Controlled Electrically from a Templet

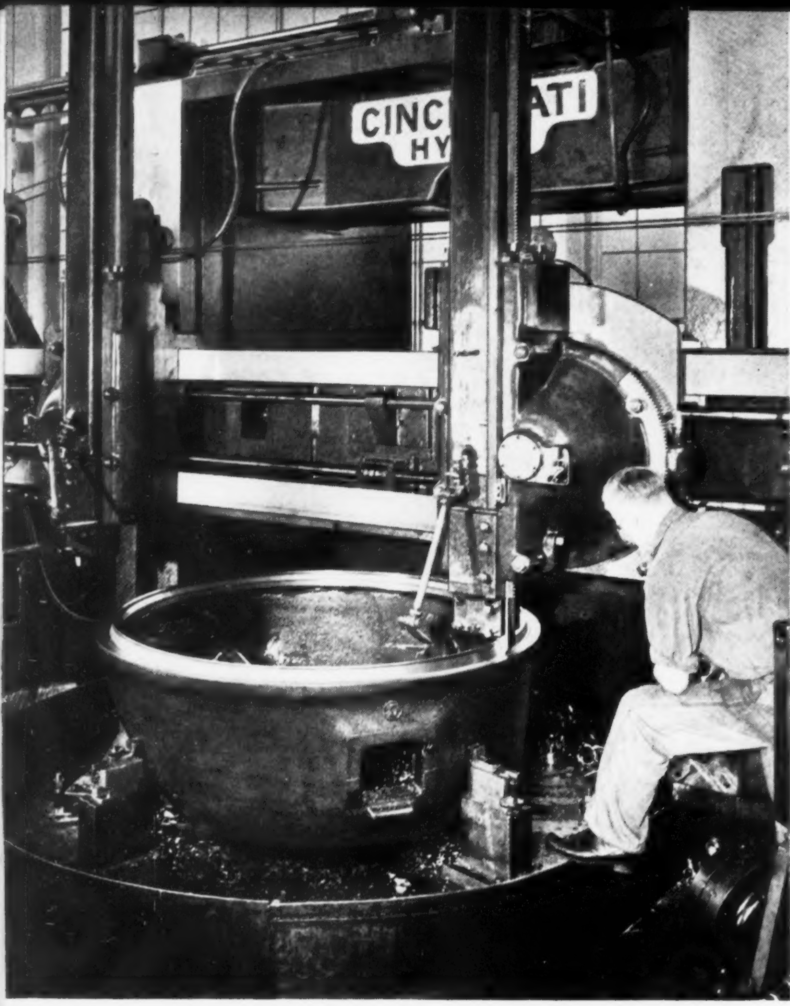


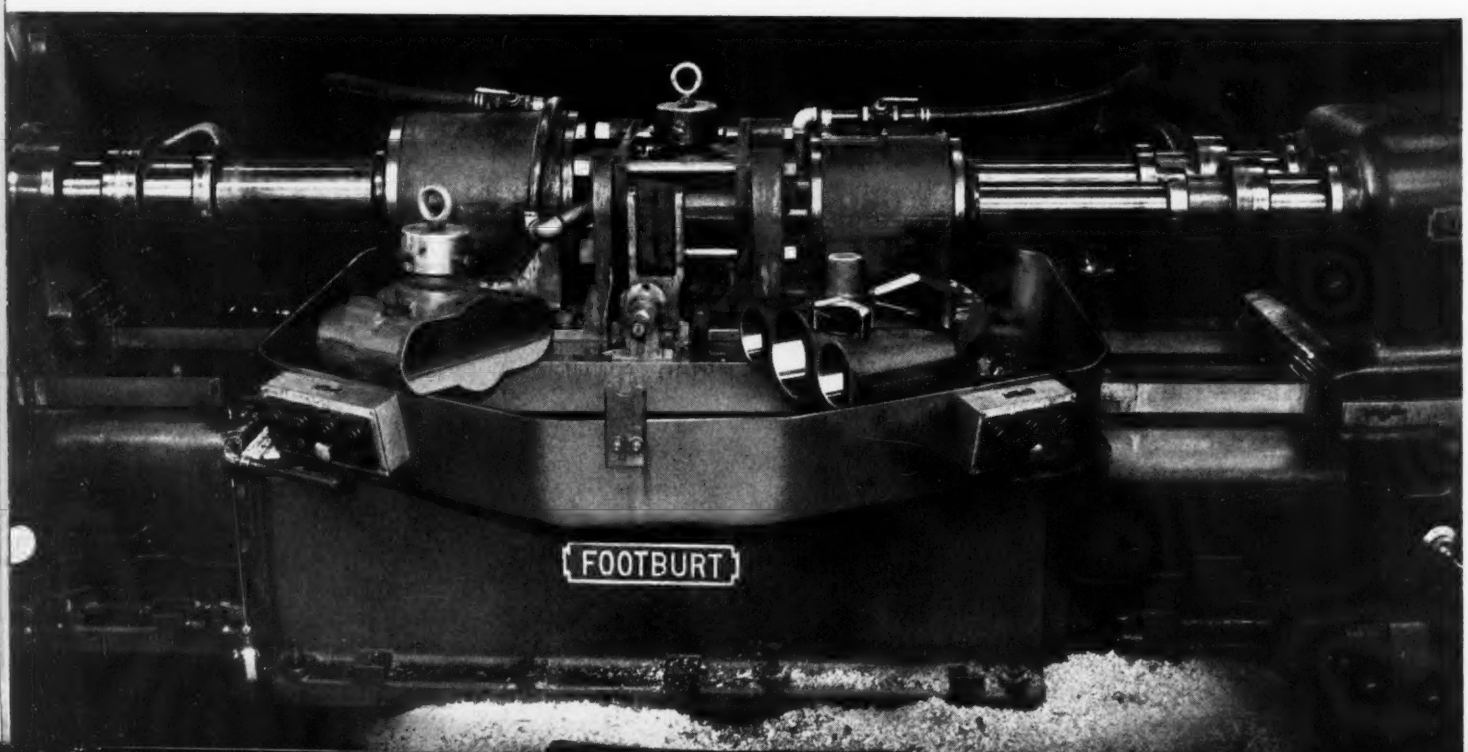
Fig. 6. Turning and Facing the Bottom of a Tank Turret. This Armor Steel Casting Weighs as Much as the Average Automobile

eously, the only exception being in the case of one station that is equipped with a tool having a cutting edge formed to the shape of a large fillet. The ram is provided with two cutters which simultaneously face two surfaces to the requirements of a "Go" and "No Go" step type of gage. Rings of seven different diameters, some larger and some smaller than the one illustrated, are required on each tank. Some of the diameters must be held as close as plus or minus 0.005 inch.

One of the many radial drilling machine operations is shown in Fig. 8 being performed on a machine with an 8-foot arm. The work being handled is a final drive housing, which is held on a heavy indexing jig that provides for revolving the work through approximately 160 degrees. A bracket furnished with drill bushings is bolted to the front of the jig for drilling a series of six holes, and is then removed to permit the drilling of other holes. Back spot-facing cuts are taken in the same set-up on some of the drilled holes.

Probably the toughest machining job in the entire shop consists of drilling two 5-inch holes and one 7 1/4-inch hole simultaneously through solid 10-inch thick gun-trunnion forgings. One

Fig. 7. One of the Most Difficult Operations in the Arsenal—Drilling Three Large Holes through Solid Armor Steel Forgings 10 Inches Thick



of the undrilled forgings is seen lying on the left side of the table on the horizontal two-way drilling machine shown in Fig. 7. A finished trunnion is seen on the right-hand side of the table. These forgings are of S A E 4140 steel. The holes are drilled completely through them in thirty-five minutes. When the forging is placed in the machine, it weighs 374 pounds, and after it has been drilled and bored, the weight is only 94 pounds, approximately 75 per cent of the material having been cut away. The walls are reduced to thicknesses of 1/4 and 5/16 inch.

The machine is provided with hydraulically actuated tool-heads which advance together. Cutter-blades of a double-edged type, such as seen on top of the drilled part, are used in rough-drilling the forgings. When the rough-drilling has been completed, the double-edged blades are removed from the tool-spindles and boring heads with two cutters each are substituted for taking finishing cuts, approximately 1/16 inch of stock being removed in finishing. The large central bore of this trunnion forging receives the gun barrel, while the two smaller bores on each side are for the recoil cylinders.

The shafts of these gun trunnions are turned

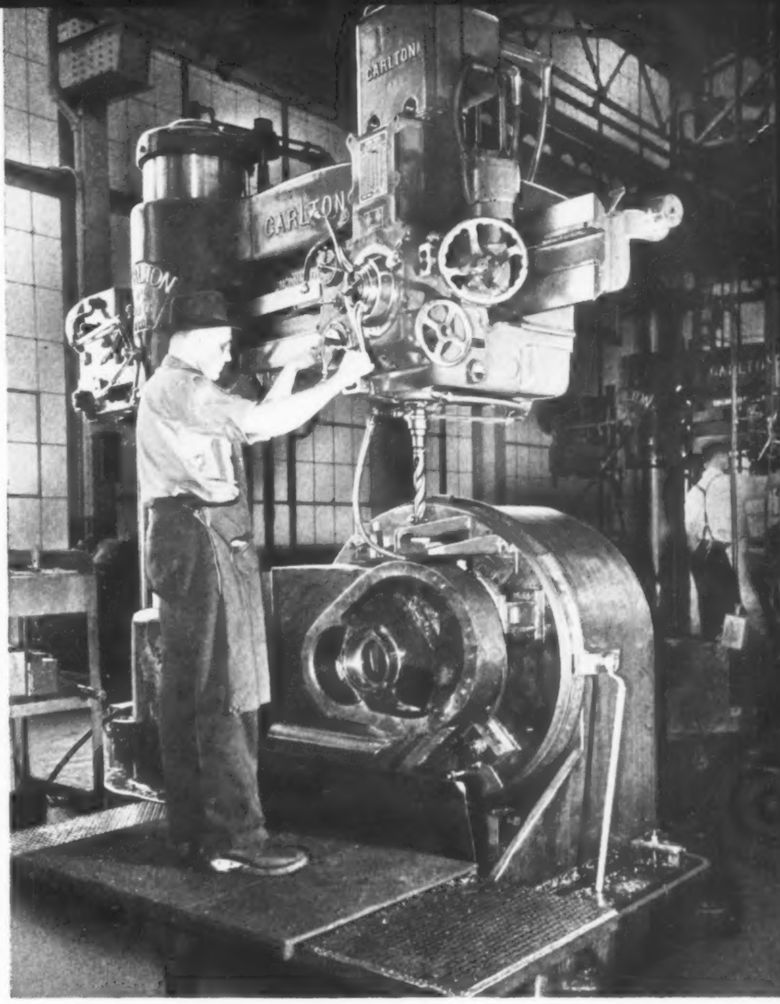
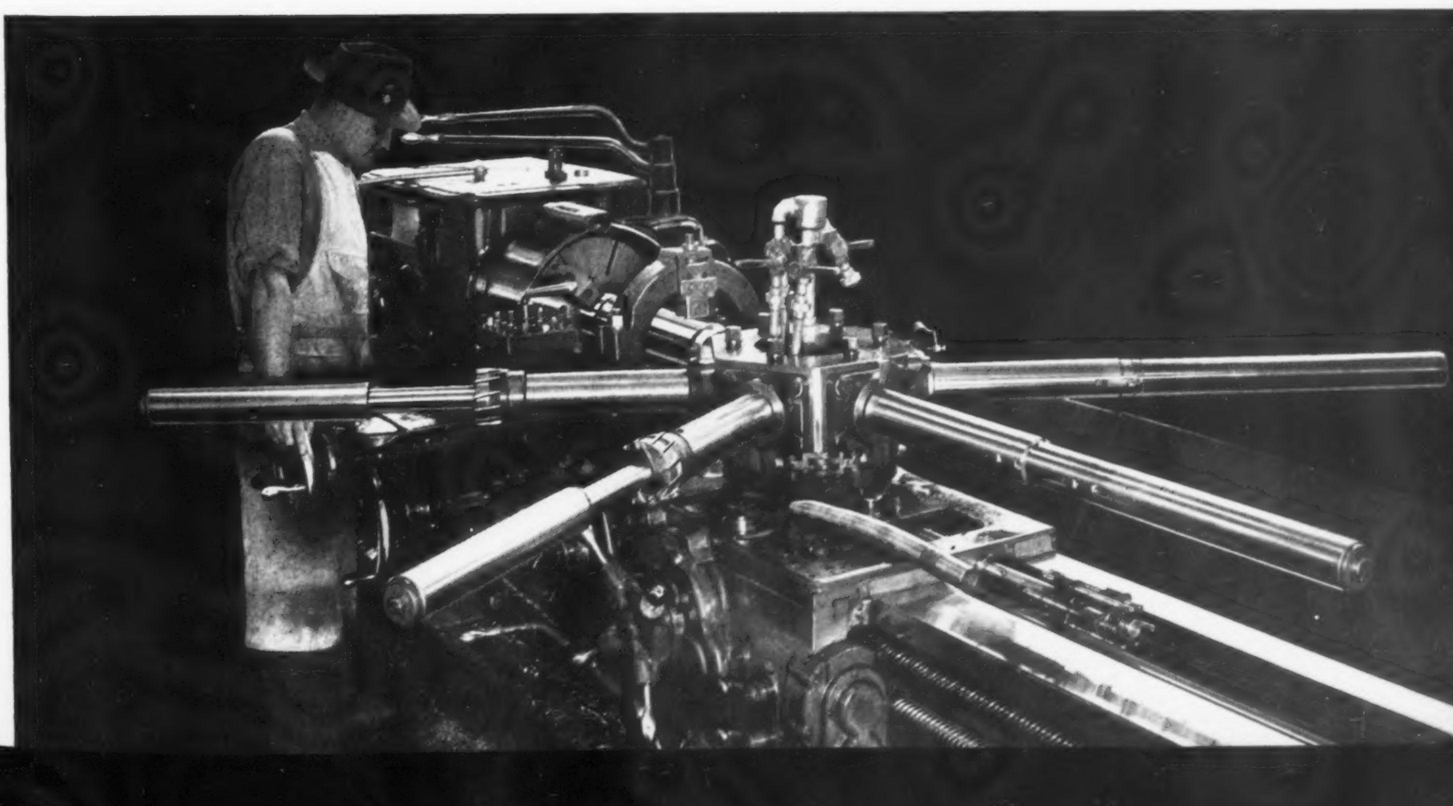


Fig. 8. Radial Drilling Machine Employed for Drilling and Back-facing Operations on Final Drive Housings

Fig. 9. Accurate Boring and Reaming of the Recoil Cylinders for 75-millimeter Guns is Accomplished with the Turret Lathe Set-up Illustrated



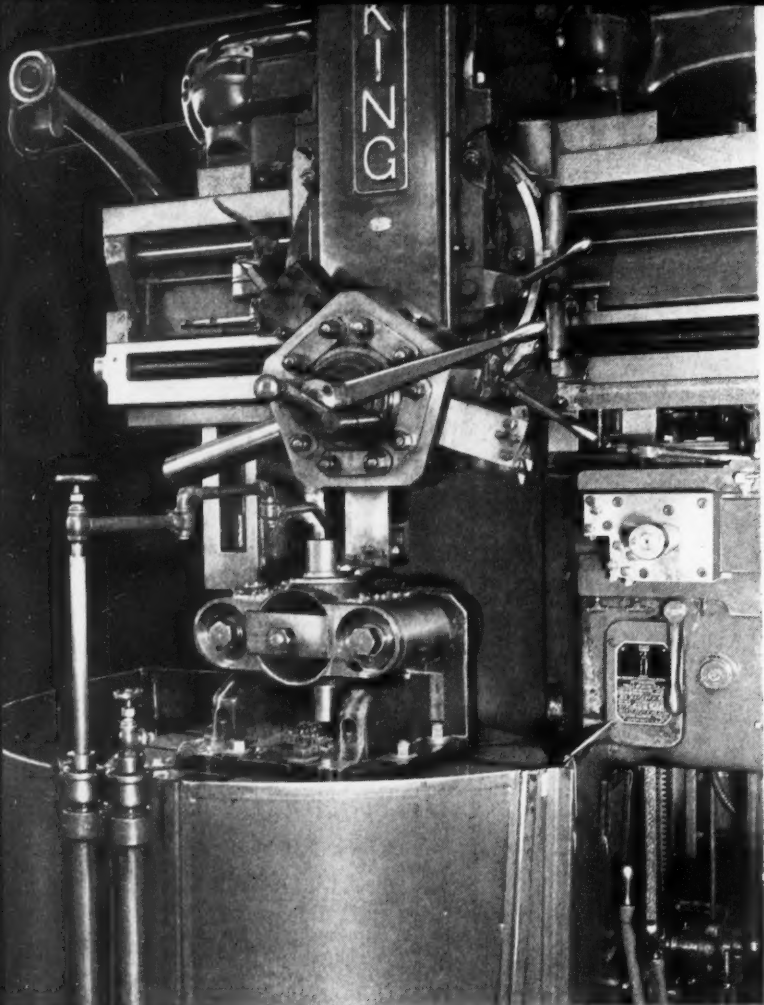


Fig. 10. The Shafts that Project from Opposite Sides of the Trunnion Forgings are Turned and Faced on Vertical Boring Mills of the Type Shown

and faced in an operation that is shown in Fig. 10 being performed on a vertical boring mill. The shafts on both sides of the forging are machined in this operation, the work being reversed in the fixture when one side has been finished. Accurate location and clamping of the work are insured by seating the bores for the two recoil cylinders on large plugs which extend horizontally from the face of the fixture. Cutters on all but one turret station are employed, as well as three cutters on the side-head. The side-head cutters face flange surfaces and the end of the trunnion shaft, all at one time.

Later, the trunnion bores are again machined on the double-end boring machine shown in Fig. 11, after a number of other parts have been welded to the trunnion to obtain a gun cradle of rather complicated construction, as seen in front of the machine. Each of the hydraulically operated tool-heads on the boring machine has three spindles. One head finishes the previously machined bores of the trunnion portion of the assembly, while the spindles of the opposite

Fig. 11. Finish-boring and Reaming Operations are Performed on the Gun Cradles by Means of the Machine Here Shown

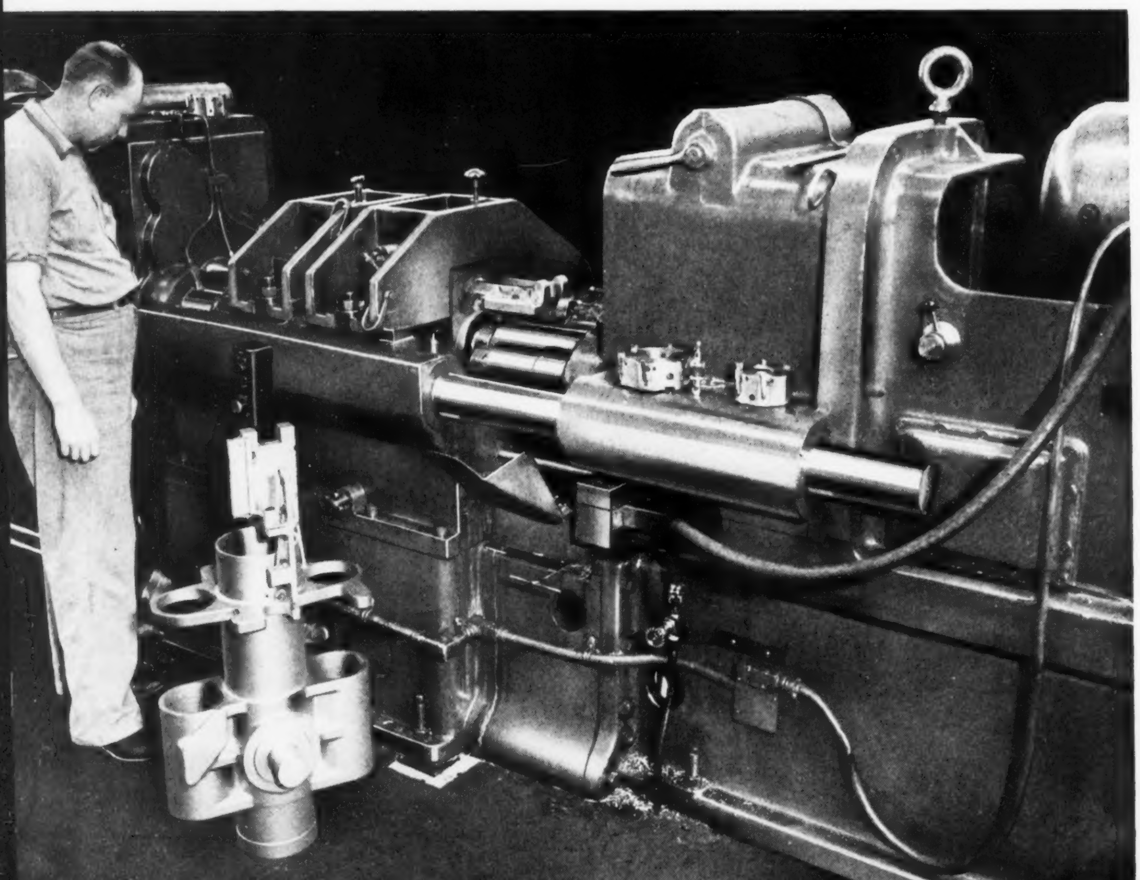


Fig. 12. The Recoil Cylinders for 75-millimeter Guns are Honed Internally on a Machine Equipped with a Fixture Designed for Quick Reloading of Work

head finish the holes that are opposite to and in line with the recoil cylinders and with the gun bore.

After the finish-boring cuts are taken, the boring heads are removed and reamers are substituted to obtain an accuracy of within plus 0.002 inch, minus nothing, for the gun bore and within a tolerance of 0.005 inch for the recoil cylinder bores. Two of the reamers are seen lying on the machine in the illustration. Close center-to-center distances between all bores is insured by the provision of heavy bars on opposite sides of the machine for guiding the toolheads in their movements.

The recoil cylinders for the 75-millimeter guns, which fit into the bores of the trunnions shown being machined in Figs. 7, 10, and 11, must be finished to extremely close tolerances as to taper and diameter. For this reason, accuracy in boring is of utmost importance. Fig. 9 shows this operation being performed on a turret lathe equipped with five reamer bars.

The bar in the first turret station is provided with a single-blade cutter for taking a rough-

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Fig. 13. Gang Planing Operation on Suspension Brackets, in which Six Cutters are Employed at the Same Time

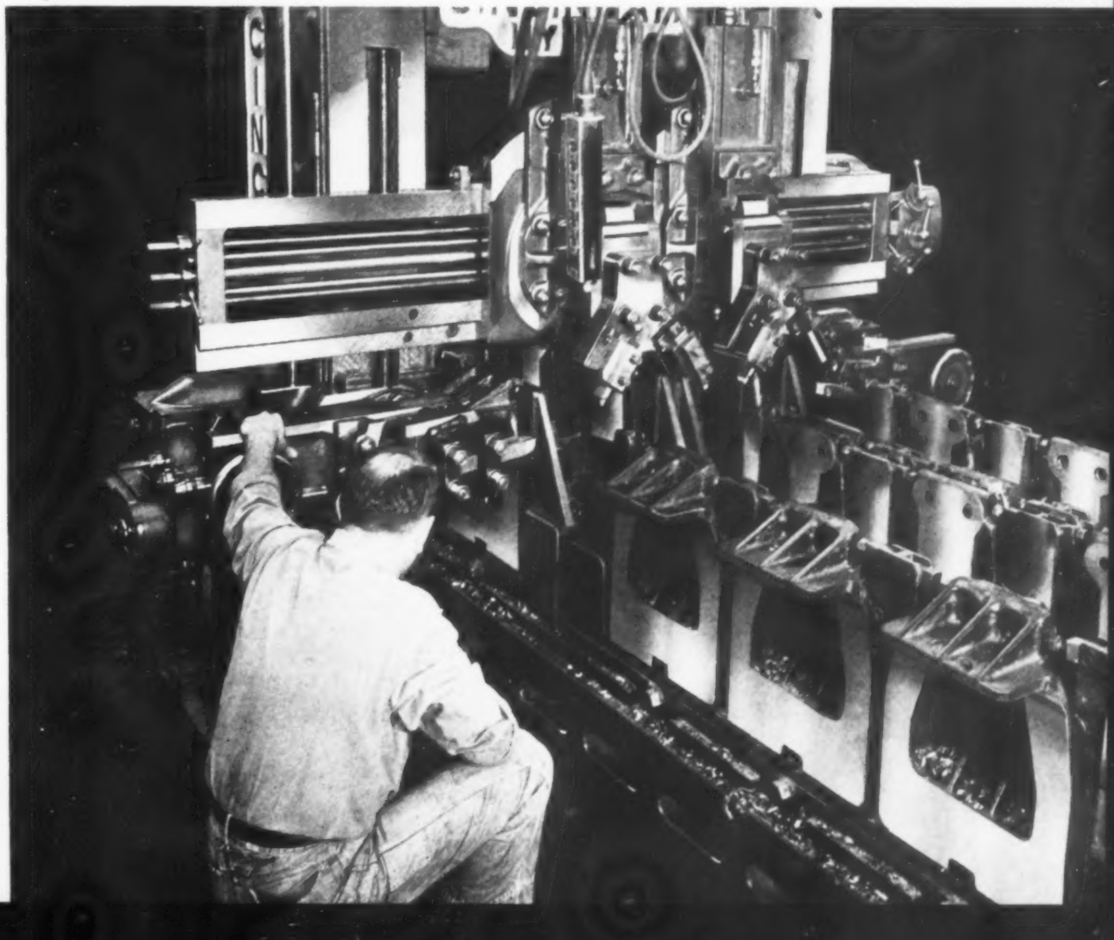

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Fig. 14. Turning and Facing the Large 75-millimeter Gun Rotor on a Lathe with Four Cutters at the Front and Two at the Rear

boring cut the full length of the cylinder. The second bar is equipped with two cutters for finishing two steps in the cylinder. Reamers are furnished on the next three bars for obtaining a particularly fine finish on the two internal diameters prior to honing. All five tool-bars on the turret are equipped with pilots 20 inches long by 3 inches in diameter which engage a bushing in the center of the headstock spindle to insure straightness of the cylinder bore for its full length. Tools on the square turret of the cross-slide are also employed for necking one end of the cylinders on the outside and turning a shoulder on the opposite end.

The honing operation is performed on the vertical machine shown in Fig. 12. This machine is provided with a fixture that slides in and out on the base, so that the cylinders can be quickly reloaded without the necessity of raising the hone higher than the position shown. When the cylinders leave this machine, the bore must be straight the full length of 30 inches within 0.001 inch, and must be to the specified diameter within plus 0.002 inch, minus nothing. The accuracy is checked with an Electrolimit gage.

Multiple tooling in a planing operation is exemplified in Fig. 13, which illustrates a set-up in which six cutters are employed simultaneously for finishing the suspension brackets that

Fig. 15. Gun Rotors are Finish-ground while Held on a Fixture that is Supported on Headstock and Tailstock Centers

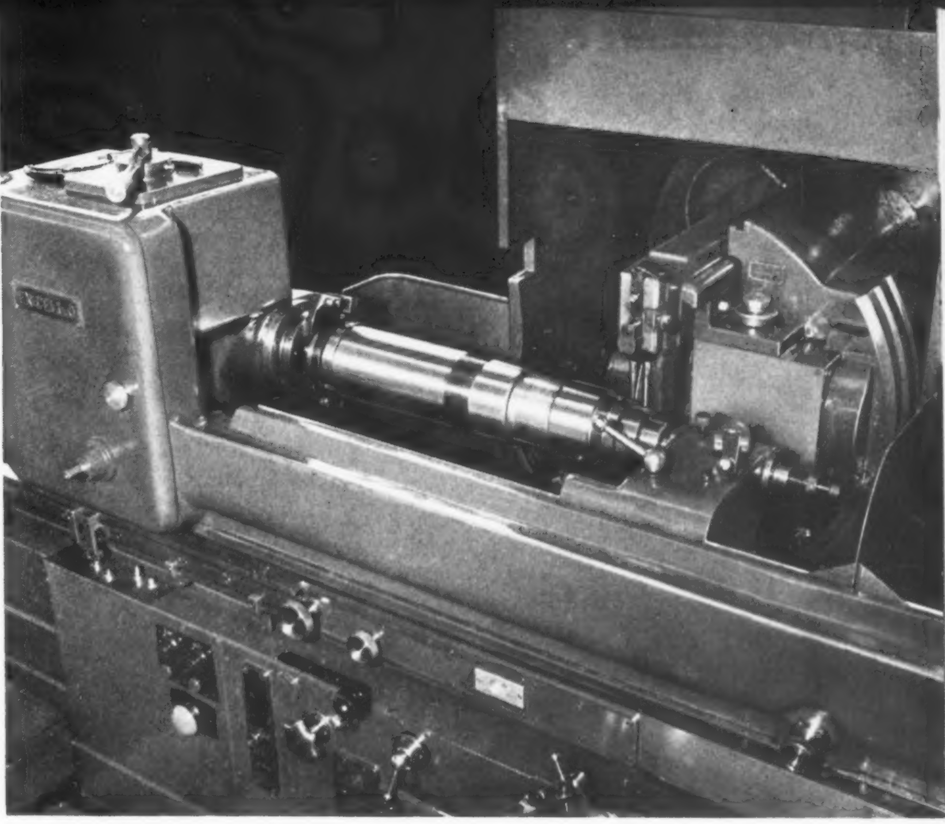

Fig. 16. Threads are Ground from the Solid on the External Surfaces of the Recoil Cylinders by Employing Machines of the Type Shown

support the tank bogies. There is one cutter on each side-head and two on each of the cross-rail heads. Twelve suspension brackets are mounted on the planer table at one time.

Cuts are taken on vertical surfaces for a distance of about 12 inches by the tools on the cross-rail heads, while the tools on the side-heads machine a vertical surface for a height of about 16 inches, and also a surface at right angles to the vertical surface on the overhanging shelf at the top of the brackets. Hardened and ground blocks mounted on supports near the left-hand end of the planer table serve as gages in setting the cutters to their approximate positions for taking the various cuts, feeler gages being used between the blocks and the tools. However, the actual tool positions, as indicated by the cuts on the work, are accurately checked by means of other gages. Although the castings are made of armor steel, cuts are taken to depths as great as 1/2 inch. All surfaces finished in this operation are checked by means of gages before the brackets are removed from the planer.

An outstanding lathe operation is performed in rough-machining the 75-millimeter gun rotors. In this operation, which is shown in Fig. 14, four tools on the front carriage are used for simultaneously turning the rotors the full length, after which two cutters on the rear

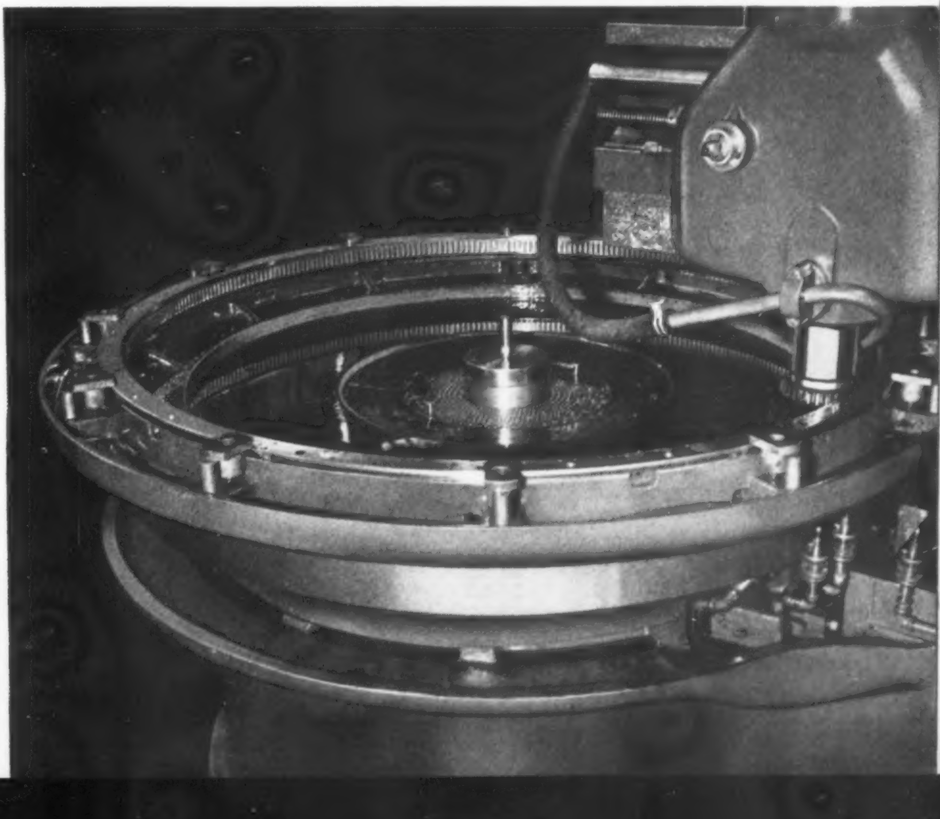

Fig. 17. Shaping Spur Gear Teeth around the Inside of a Turret Driving Ring over 4 1/2 Feet in Diameter

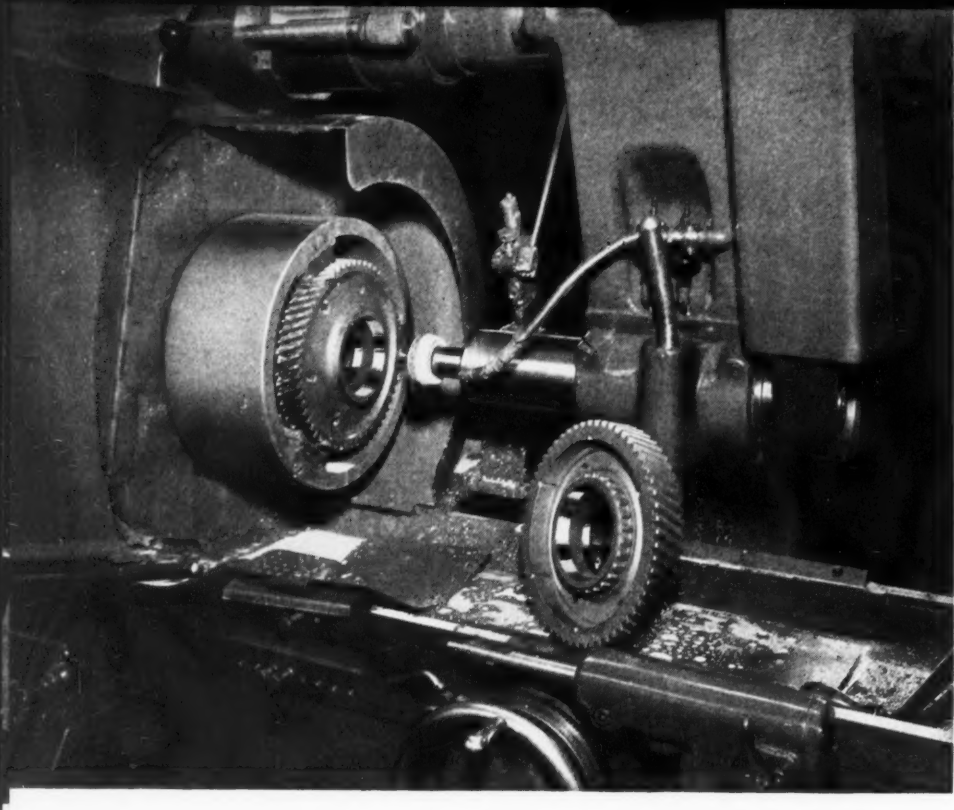

Fig. 18. Grinding Machine Set up for Finishing Bevel Surfaces at Both Ends of the Bore in Synchronizing Gears

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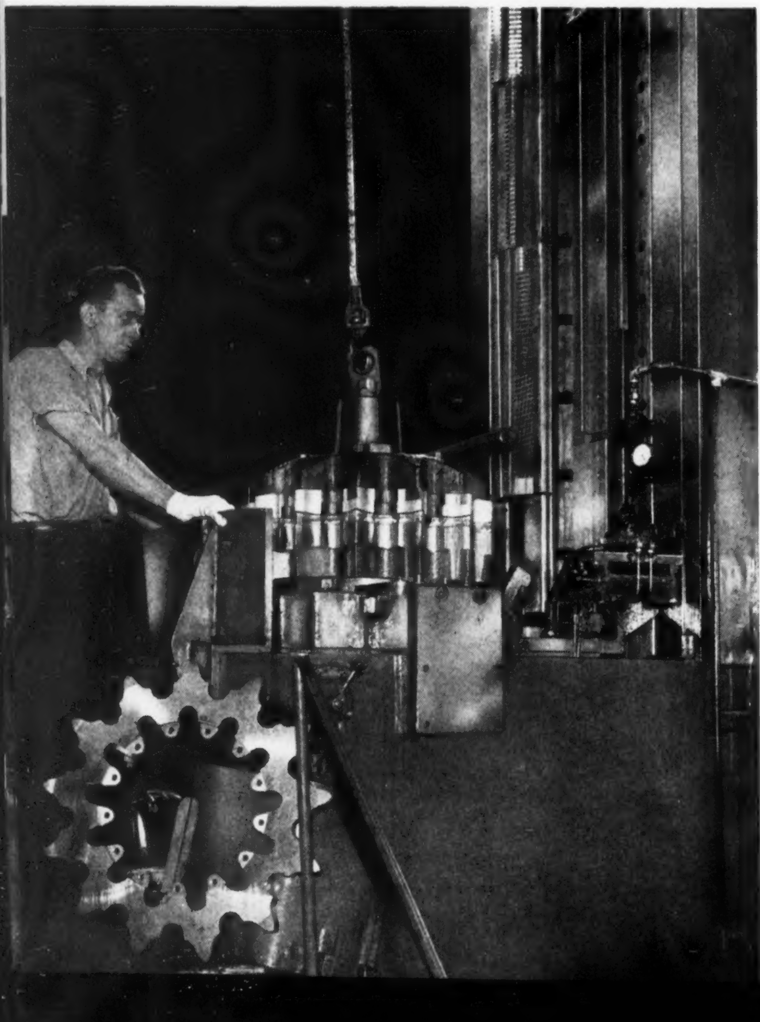
Fig. 19. The Contact Portions of Sprocket Teeth are Broached on a Machine Equipped with a Hydraulically Operated Fixture



carriage are advanced for facing both ends of the rotors. The castings consist of a long cylindrical section in the center and a large-diameter drum-like section that extends half way around the part. Because of this construction, the turning cuts are interrupted, which increases the difficulty of the operation, particularly since the castings are of armor steel. Steady rotation is insured by mounting the work in a heavy fixture that serves as a counterbalance for the unsymmetrical part. Firthite tools used in this operation take cuts to a depth of 3/8 inch.

These rotors are finish-ground on the cylindrical grinding machine shown in Fig. 15, after plugs have been inserted in the bores that extend through the rotor wall. For this operation, the rotor is mounted on a fixture equipped with blocks on the ends to receive the centers of the headstock and tailstock. This fixture is also designed to serve as a counterbalance, which insures steady rotation and accurate grinding. On the diameter, which is about 30 inches, the limits are plus nothing, minus 0.010 inch.

Three threads are ground externally on the recoil cylinders to a Class 2 fit by thread grinding machines such as shown in Fig. 16. These threads are all ground from the solid. One of them is ground near the small end for a width of 3/4 inch, another near the center of the cylinder for a width of 1 3/4 inches, and the third at the opposite end for a width of about 1 inch. The latter thread is ground in a second machine. All of these threads are of the same

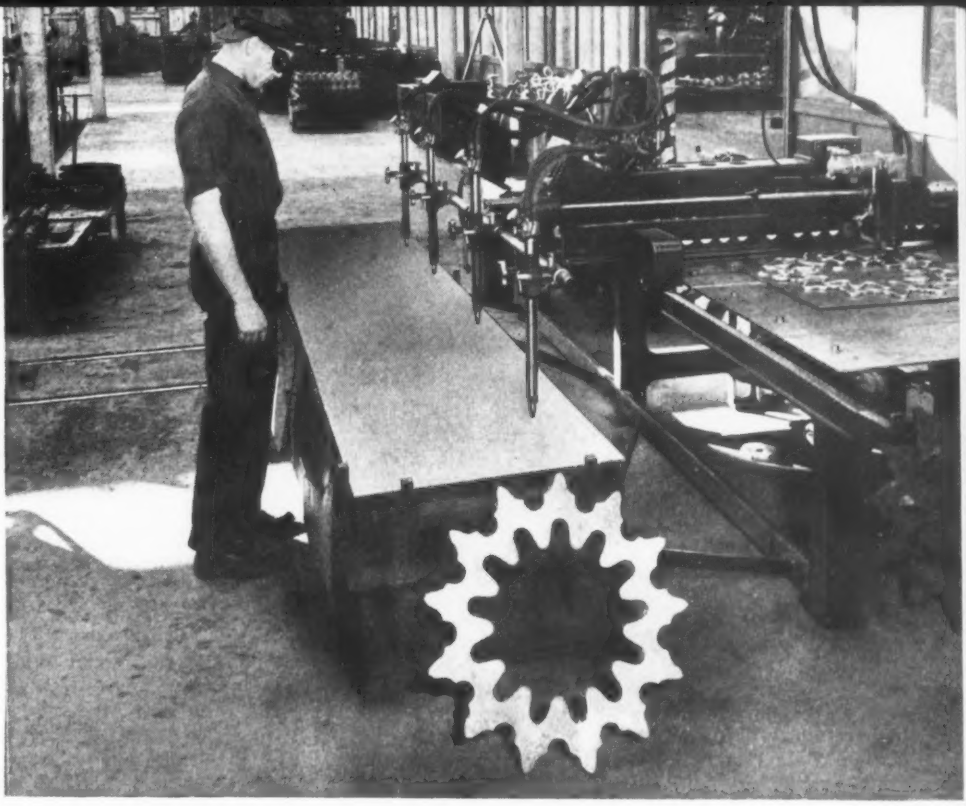


Fig. 20 Sprocket Gears are Cut out Four at a Time along Outside and Inside Contours with Oxy-acetylene Equipment

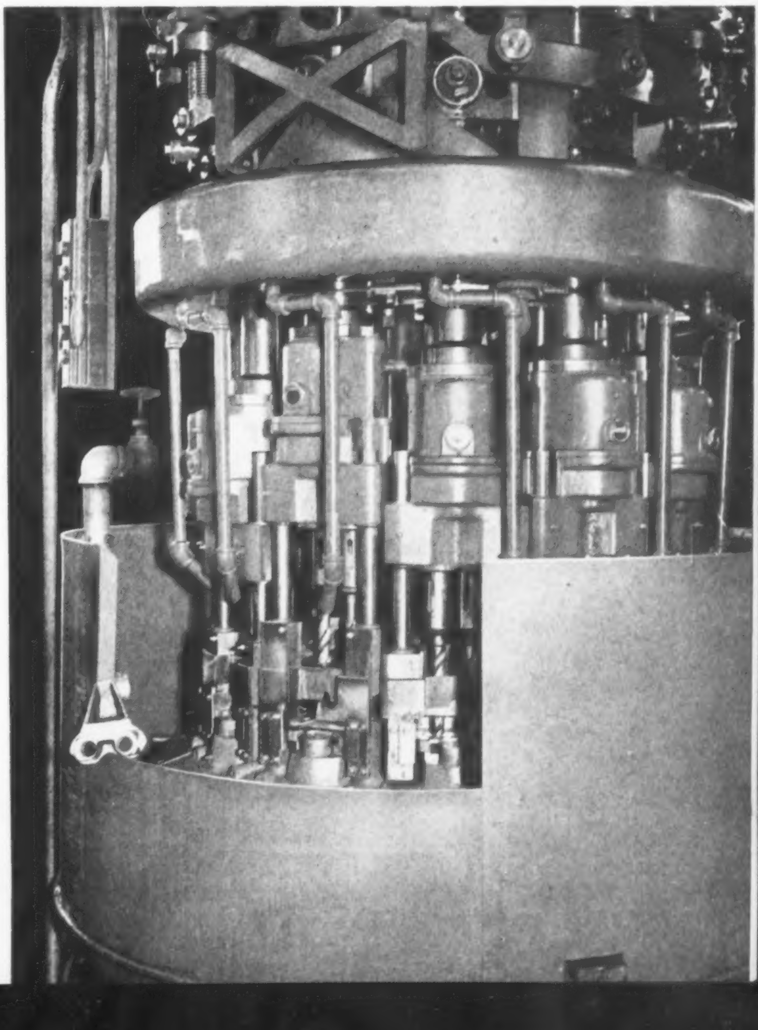
number per inch, but the diameters are different, as may be seen in the illustration.

The gear department is equipped with a large variety of modern machinery, most of which performs standard operations. In Fig. 17 a gear shaper is engaged in cutting internal spur teeth on a turret ring somewhat larger than 4 1/2 feet in diameter. Roughing and finishing cuts are taken in one set-up.

In Fig. 18 is shown a chucking grinder set up for grinding bevel surfaces at both ends of the bore in a spiral-tooth synchronizing gear. The tapers are held within an accuracy of plus 0.0007 inch, minus nothing. Use is made of a grinding wheel trued to a double bevel.

When the grinding wheel has been fed into the work until the first half is in line with the front tapered surface of the bore, the grinding spindle is rocked sidewise to permit a traverse grind of the taper. When the grinding of this surface has been completed, the wheel-spindle is rocked back into line with the center of the gear, and is then advanced into the work to bring the second bevel of the grinding wheel into line with the bevel surface on the back side of the gear. The grinding spindle is then rocked toward this bevel surface for a traverse grind, after which the spindle is returned to the center of the gear and the grinding wheel withdrawn. The rocking movements of the arm which carries the grinding spindle are effected by a cam at the back of the grinding machine. The cylindrical surface in the center of the gear is approximately 4 1/2 inches in diameter.

Fig. 21 Rotary Type of Continuous Drilling Machine Employed in Drilling Two Holes through Shoe Track Connections



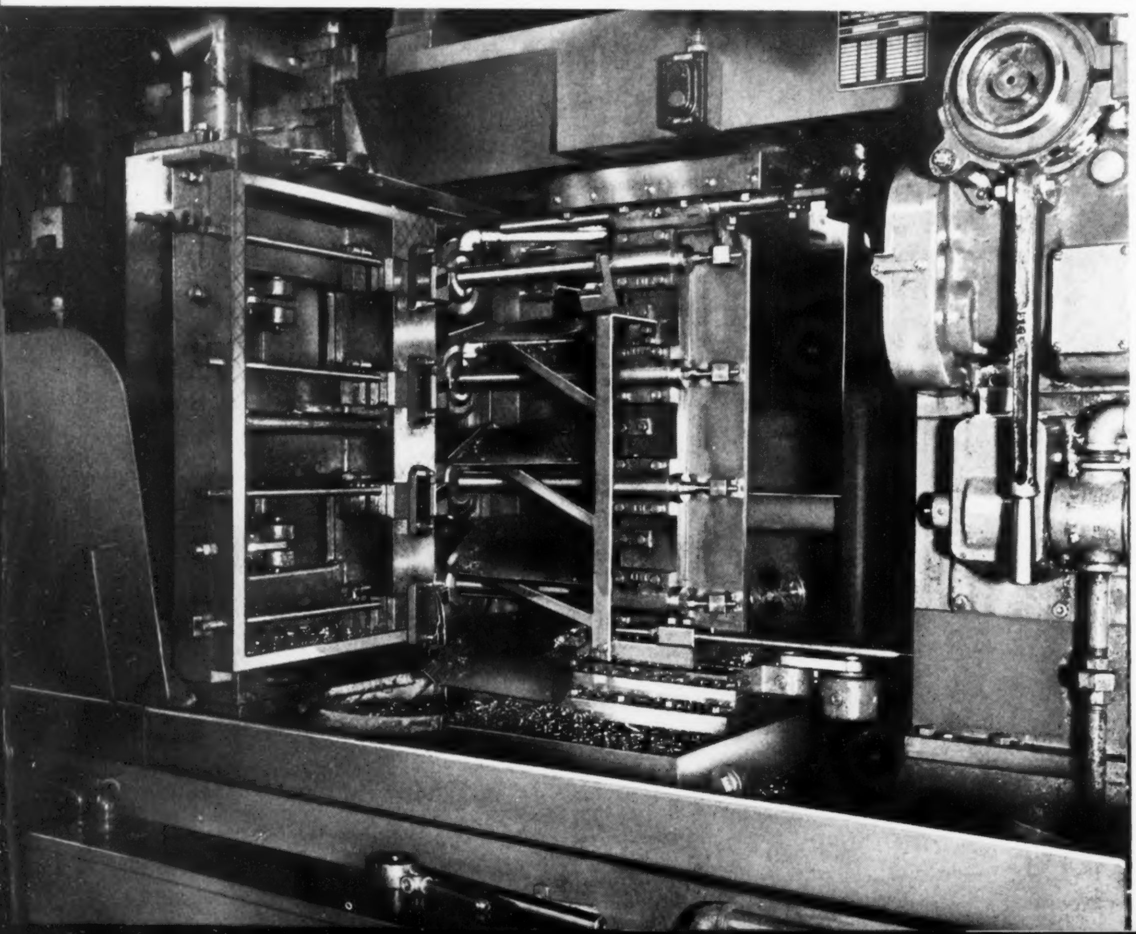
The sprocket wheels that drive the tractor shoe tracks or caterpillar treads are cut from tough steel plate, four at a time, by employing the multiple-torch oxy-acetylene cutting equipment illustrated in Fig. 20. The sprockets are cut out completely, both along their external and internal contours, as indicated by the example seen in the foreground. The steel plate is laid on a table at the front of the machine for this operation, and after being positioned, four torches are automatically guided over the plate by a tracer following a templet of the required contour, which is placed on the platen of the machine, as seen at the right. The tracer head is equipped with two fingers that follow opposite sides of the templet, separate templets, of course, being provided for the external and internal contours of the sprockets.

Although surfaces possessing a high degree of smoothness are obtained by this method of cutting the sprockets, Army specifications require that the sprocket teeth be broached around their contact surfaces. This operation is performed by means of the vertical hydraulic broaching machine shown in Fig. 19. Two sprockets are broached at a time. They are clamped on the fixture by means of a heavy head, which is lifted to and from the work through the use of an overhead hoist. The heavy top casting guards against the possibility of the sprockets rising during the taking of the cuts.

The broaching fixture is mounted on a slide which moves forward to clear the broach sections on their return stroke toward the top of the machine. Then the fixture indexes to bring the next tooth of the sprockets into position for the broaching operation, after which the fixture slides toward the machine column to bring the sprockets into the correct position for the next downward stroke of the broaching ram. Stock is removed for a length of about 1 1/2 inches on each side of the sprocket teeth. When the fixture has been indexed twelve times, as required for broaching thirteen teeth, the operation stops automatically.

One of several continuous rotary drilling machines is shown in Fig. 21. The particular machine illustrated is provided with twelve heads that carry two drills each for drilling opposite ends of shoe track connections. The drills

Fig. 22. High-production Machine Employed for Cutting off Tubes, Four at a Time, for Use in Making the Tank Shoe Tracks



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are 1 3/32 inches in diameter and drill through bosses 1 3/4 inches thick. After the fixture in each station has been loaded, the work-piece is carried completely around the machine, during which time the drill heads continue feeding downward, so that the part is completely drilled through when it again reaches the loading station.

The tubes used in making the shoe tracks are cut to length four at a time by the machine illustrated in Fig. 22. The 1 3/4-inch diameter tubes are cut to length by tools mounted on the large cross-slide at the front of the machine, as seen at the left. This slide advances automatically toward the center of the machine each time that the four pieces of tubing have been fed forward until their front ends register against stops. The overhanging ends of the tubes are supported by rollers that are adjustably mounted on the upright member near the center of the machine, which is bolted to both the table and the top of the machine. Just behind the points where they are to be cut off, the tubes are gripped and rotated by conventional collet chucks. When they have been cut off, they roll to the bed of the machine, while the cross-slide returns to its forward position, ready for the next feeding movement of the tubes.

Slots of a high degree of accuracy are broached on opposite sides of the sleigh for 75-millimeter guns by the horizontal broaching machine illustrated in Fig. 25. One of the finished pieces is seen lying on top of the machine. The part is loaded in the broaching fixture with the side to be broached pointing downward. The slots are approximately 26 inches long. The width across both slots must be held to size within plus or minus 0.002 inch, while the height of the slots must be held within plus or minus 0.001 inch. The sleigh is a built-up member obtained by welding a tubular piece to a steel forging.

The twelve bogie wheels of the tanks are of welded steel fabrication, and are provided with solid rubber tires. These tires reach the plant molded on thin steel rings about 12 inches wide. The rubber-tired rims are pressed tightly on the wheels by employing the 300-ton hydraulic press shown in Fig. 24.

Fig. 23. Six Bell Type Furnaces, Serving Twelve Work Stations, Expedite the Carburizing of Gears and Gear Shifts

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Fig. 24. Employing a Hydraulic Press for Assembling Rubber-tired Rims of Bogie Wheels

In a convenient location near the center of the shop is an exceptionally modern heat-treating department, which contains equipment for annealing, carburizing, normalizing, hardening, tempering, and other heat-treating operations. It includes a battery of gear quenching machines.

Six bell type carburizing furnaces, such as seen in the background of Fig. 23, are a feature of this heat-treating department. These carburizing furnaces are used in pairs, each pair serving four carburizing stations. Batches of work to be carburized can be loaded in carburizing boxes, placed one on top of the other, as seen in the right foreground and the furnaces can then be lowered over them by means of an overhead crane. With this arrangement, boxes of work can be allowed to cool in the room atmosphere and the boxes reloaded, while work previously loaded in boxes located in the other two stations are being carburized.

The three carburizing boxes seen in the right foreground are loaded with final drive and transmission gears and carburizing compound, ready for the furnace immediately in back of them to be placed over the work. In the left foreground are seen two boxes containing gear shafts that have previously been carburized and that are undergoing slow cooling.

Fig. 25. Broaching Operation Employed in Finishing Slots that Extend the Full Length of the Base on Gun Sleighs within Close Tolerances

Munitions Cleaning—1941 Style

A Review of the Methods and Solvents Applicable to the Cleaning of Shells, Cartridges, Guns, Rifles, and Other Materiel—Last of a Series of Articles

By Dr. R. W. MITCHELL, Technical Director
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IN the preceding articles of this series, the various methods and solvents used in the cleaning of shells, cartridge cases, and fuses were covered and some of the general cleaning problems on ordnance and materiel were discussed. In this final article, some factors to be considered in securing a chemically clean surface will be reviewed, as well as problems involved in cleaning oil-quenched steel parts and in stripping paint and lacquer from rejected units.

The emulsifiable solvent method of cleaning already discussed appears to show great promise, not only as a precleaning process where no further cleaning is required, but also as the first step in a two-stage process where a chemically clean surface is necessary. It has the advantage of great speed, since a short soak — in many cases a dip—will insure penetration and loosening of all bonds between dirt and metal, so that the subsequent pressure rinse will flush off dirt, grease, and emulsion at the same time, leaving a metal surface free from all impurities, except for a thin film of the diluent used in making up the cleaning solution. This diluent, whether it be kerosene or safety solvent, will have no effect on the quality of the painting, lacquering, or other finishing operation where plating or vitreous enameling is not required. It is readily removed, together with all traces of impurities, when a chemically clean surface is required, through the use of the right type of cleaner in the electroplating tanks, still tanks, or washing machines used for such operations.

The emulsifiable solvent type of cleaning is applicable to practically all the metals encountered in the production of munitions and materiel. It is particularly effective on steel, but has been widely used on aluminum, Duralumin, zinc, lead, tin, Monel metal, copper, brass, bronze, and stainless steel. To put it briefly, it seems probable that for speedy, economical, and reliable cleaning for most objects where plating or vitreous enameling is not required, the emulsifiable solvent method offers the best answer to the frequent cases where ordinary alkaline washing does not yield satisfactory results.

When the work must have a chemically clean surface, we are forced to return to an alkaline type of cleaner, but it must be of a modern type, based on the latest developments in the theory and practice of cleaning metals. The trend today toward the use of electrocleaning tanks, for example, makes it vitally important that the alkaline cleaner used in such tanks be capable of faster wetting and quicker and more complete penetration. If the full benefits of the electrocleaning tank are to be obtained, so that the work will have a chemically clean surface, free from "water break," and with all impurities removed, even from microscopic openings and fissures, the rinsing qualities of the cleaner should have the closest attention.

Drag-over and scum, with their consequent troubles in succeeding dips or plating baths, can be a serious source of rejections as a result of improper choice of cleaning material. Selection of the right cleaner for use following precleaning to insure a chemically clean surface for plating is a matter of fitting the cleaner to the type of metal involved plus free use of the trial and error method of determining the one that works best.

It should be pointed out here that the common mistake of buying metal cleaners on a first price basis is one that must be avoided in connection with munitions and materiel. The measure of the cost of a cleaner is not its price per pound, but its cost per square foot cleaned, compared with a similar figure for competing materials, taking into account all essential performance factors involved. The worth of a cleaner should be judged by the quality of the job it does and the relative number of rejections produced. Nor must the speed of cleaning nor the comparative need for hand operations be overlooked. For example, one cleaner may cost less per pound than another and clean as well as the higher priced one—at as fast a rate—but if, to get a complete job, hand brushing or scrubbing is necessary in the case of the cheaper cleaner, where the more expensive material does the job without manual operations, economy does not lie in selecting the lower priced compound.

Cleaning Oil-Quenched Steel Parts

A problem that requires special attention is the cleaning of oil-quenched steel parts—an operation that is more than usually common today in connection with ordnance and much materiel. Quenching oils, subjected as they are to high heat for long periods, tend to break down materially, forming sludge or partially carbonized oil, and develop considerable acidity. In a relatively short time, they thicken to a point where they are particularly hard to wash off the tempered steel.

Ordinary cleaners which do a good job on the removal of cutting oils and the usual kinds of dirt cannot be used here. In fact, a strongly alkaline type of cleaner, usually called "heavy duty," is essential. Since only a few very low titer soaps are compatible with, or active in, highly alkaline solutions, it is important that a cleaner of this type be carefully compounded, in order that the needed emulsifying power of the alkali be combined with the wetting and penetrating action of the soap to do an effective cleaning job and insure adequate rinsing of the work.

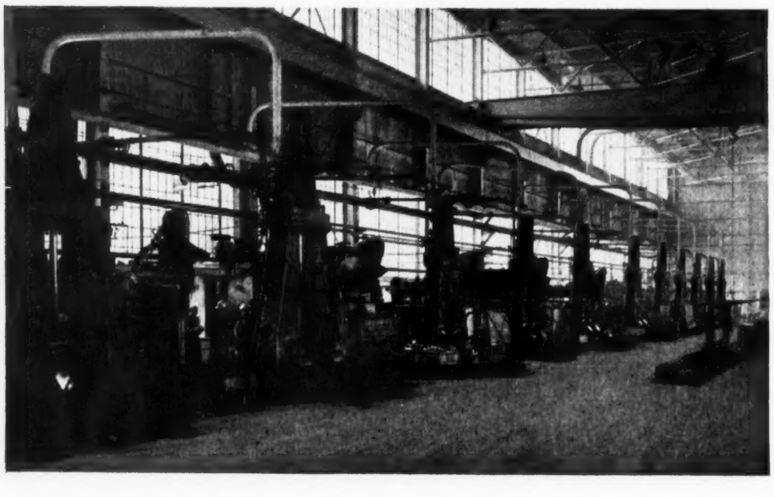
In cleaning such oil-quenched parts, the work is soaked in a boiling solution of the cleaner at a concentration of about 8 ounces per gallon of water. This loosens the heavy oil deposits and maintains the emulsified dirt in suspension. The work is then rinsed clean with boiling water in a still tank. The time required in the cleaner varies widely, ranging from 15 minutes to 3 or 4 hours, depending on the nature of the oil deposit. These heavy-duty cleaners are all highly caustic, and are capable of doing serious injury to the skin and eyes. Workers should be protected with rubber gloves, aprons, and shoes, as well as goggles. Any drops or splashes on the skin should be promptly flushed away with water, and the area affected wiped with boric acid solution or vinegar and finally coated with castor oil or unguentine.

Stripping Paint and Lacquer from Rejected Units

Another special problem, which is intensified under the Defense Program, is the removal of paint, lacquer, and similar coatings from rejected parts and units prior to reworking. The same kind of heavy-duty cleaner used for oil-quenched parts is applicable here. The work is soaked for 15 minutes in a boiling 8 ounce per gallon solution. At the end of this time, the coating is softened and puckered to such a degree that it can be knocked off with a high-pressure steam or water jet. All paint and lacquer can be removed in the soak tank, without using the jet, by boiling for longer periods. This, however, leads to heavy contamination and greatly shortens the life of the solution. The use of the pressure jets is far preferable.

Work should be well rinsed in hot water after coatings are off to remove all traces of the cleaner and speed up drying, thereby minimizing rust formation. As previously noted, these strong alkaline cleaners are hazardous and require a rigid safety procedure and the use of rubber aprons, shoes, gloves, and goggles.

Cleaning is a small though vitally important phase of the Defense Program. After all, rearmament is basically a problem in metal production, and where metals are processed, cleaning is so important a part of the production plan, that a bottleneck in the cleaning phase is a major constriction in the entire production flow. The relatively low cost of cleaning bears no relation to the importance of the operation. Hence due emphasis should be placed on the careful consideration of both methods and materials when the cleaning phases of defense production come up for consideration.



With Approximately 17 Per Cent of the Aluminum Produced Today Going into Military Planes in the Form of Forgings, the Aluminum Co. of America has been Forced to Treble its Forging Capacity at its Four Forging Plants. At the Vernon, Calif., Plant there has been a 350 Per Cent Increase in Capacity. A Row of Eleven of the Twenty-one Hammers in that Plant were Producing Forgings for National Defense even before the Floor in the Building had been Completed

Engineering News Flashes

The Autosyn—a Device that Keeps the Aviator Posted

Though it weighs but 7 ounces, the Autosyn, a tiny precision device developed by the Pioneer Instrument Division of Bendix Aviation Corporation, plays a vital role in aviation. Its function is to show, on the aircraft instrument panel, exactly what is taking place in such parts of the ship as the engine, landing gear, rudder, etc. The Autosyn works in pairs, one unit being a transmitter and the other a receiver. The transmitter is attached to the landing gear, for example, and is connected electrically with a receiver linked to a dial before the pilot's eyes. The slightest movement of the landing gear moves the transmitter rotor, which, through a three-phase electrical connection, sets up an exactly corresponding motion in the rotor of the receiving Autosyn. The movement of the latter activates a needle on the dial, so that the pilot can tell at a glance the position of his landing gear. Twenty or more of these units may be used on a single ship.

No Rejections in 2,000,000 Shafts Hardened Inductively

The heating time for hardening crankshafts has been cut from twelve hours to less than five minutes by 2000-cycle inductive heating at the Chicago tractor plant of the International Harvester Co. Five different sizes and types of shafts for Diesel and gasoline engines are affected by this saving. The method has simplified balancing, obviated the normal pickling processes, and increased core toughness. With this installation, which was the first licensed by the Ohio Crankshaft Co., Cleveland, Ohio, more than two million shafts have been hardened without a rejection.

Formerly the drop-forged shafts were normalized, hardened and drawn, pickled or shot-blasted to remove scale, and then machined and ground. Though the durability of main bearings and connecting-rod bearings is almost directly dependent upon their hardness, this physical property was limited by machining operations after hardening. Carburizing these particular shafts was not a practical means of hardening, because distorted shafts could not be satisfactorily straightened afterward. The final hardness was between 25 and 30 Rockwell C.

Shafts are now normalized, completely machined except for final finish, then heat-treated on the bearing surfaces only to a hardness of from 55 to 62 Rockwell C, drawn at 350 degrees F., and ground. Pickling is no longer necessary, since inductive heating introduces no scale. Using conventional hardening methods, shafts previously were made of a nickel-alloy steel of the 3100 series, which has now been made almost unavailable by defense restrictions. With inductive heating, the more costly nickel steel has been replaced by a readily available carbon-chrome steel. Total rejections for metallurgical defects have been reduced from the previous 5 per cent to an average of less than 1 per cent. Power for the inductive hardening is supplied by Westinghouse 2000-cycle generators.

New Laboratory Provided with Clean Temperature-Controlled Air

Complete control of atmospheric dust and gases has always been one of the dreams of laboratory workers. It may not be generally understood that many of the tasks performed in the analytical laboratory of steel producers are extremely sensitive to contamination of the air. Take, for example, determination of gases in steels and other alloys. In many phases of this work, it is literally true that "the best working conditions are not good enough."

In planning the new Harper Chemical Laboratory of the Vanadium Corporation of America at Bridgeville, Pa., an effort was made to obtain the most ideal conditions possible. To prevent the entry of dust or gases from without, an air-control system creates a constant positive pressure inside the building. This is accomplished by delivering slightly more air into the rooms than is exhausted. All windows, except those in the basement, store-rooms, and wash-rooms are glass block laid in mortar. Such windows afford an air-tight surface and also an air-tight connection between windows and walls.

The positive pressure inside the building produces a flow of air outward from the laboratory rooms through the doorways and stair shafts. The control of the cleanliness of the air and its temperature is further facilitated by unusually large insulating air spaces in the walls and roof. The inside doors are of the Kalamine type, having a wood core covered by sheet metal. The outside doors are of hollow metal.

During the short time this building has been in use, the air-control system has met all expectations, and the elimination of dust and contaminating materials is said to be virtually ideal.

EDITORIAL COMMENT

It is encouraging to note that at last voices are being raised in Congress denouncing the sabotaging of the nation's Defense Program by that group of labor leaders who place their own interests ahead of those of working men and women and of the best interests of the country at large. At the present writing, however, the attitude of the President and the Administration in regard to labor disturbances in the defense industries is less encouraging; to exhort industry and labor to end industrial strife without suggesting a revision of the one-sided Wagner Act is obviously futile.

Defense Production Comes Ahead of All Personal Gains

Ever since the Allis-Chalmers strike, it should be obvious to anyone what the influences are that are back of many of these strikes. The majority of American working men and women are not willing to jeopardize the safety of their country by holding up defense production; the only explanation is that they are coerced by a small minority that serves purposes subversive to the national welfare. That, it appears, was amply demonstrated in the Allis-Chalmers strike, and indications point to similar conditions in several other labor disputes.

It is to be regretted that at a time of so serious a national emergency, the Administration appears to lack backbone in dealing with the actions of those labor leaders who are willing to jeopardize the national interest in order that they may gain their own ends.

If men and women willing to work to produce for the defense of their country are prevented from doing so by intimidation and violence instigated by men calling themselves labor leaders, are Congress and the Administration doing their duty?

Present Allowances on Shell Forgings Too Great

Government specifications call for quite large allowances on forgings for shells. These allowances were established in the days when forging equipment and forging methods were not so highly developed as they are now, and when larger allowances, consequently, were necessary.

At present, shells can be forged with a very small allowance for machining; yet concentricity can be held so accurately that a perfect shell surface is assured after machining. It does not seem, therefore, that the large allowances on forgings used twenty years ago should be demanded today. Smaller allowances mean a saving in every direction — less steel in the shell forging, less material to be transported from forging plant to shell-turning plant, less machining work, fewer chips to be handled, and less demand upon the shell-turning machine. All this means reduced costs. Doubtless the specifications will be changed when the responsible ordnance officers are thoroughly convinced that modern forging methods make smaller allowances satisfactory. In this, as in many other fields, the progress made during recent years in equipment and methods permits great savings without sacrificing quality.

Trained Men to Act as Precision Tool Inspectors Scarce

Several manufacturers, especially those making precision tools and equipment for munitions manufacture, have had difficulty in finding good inspectors. This, in fact, is one of the factors that seriously limit the expanding of their manufacturing facilities. A competent inspector cannot be trained by short-route emergency methods, especially on work of this kind. Experience and training acquired over a period of years is a prime essential, in addition to other qualities necessary to do inspection work successfully. It is especially important that the manufacturer have experienced inspectors in the case of precision tools and similar equipment, since it is not likely that the Government can find a sufficient number of experienced men to act as inspectors in this particular branch of industry. Hence, the manufacturer himself must assume the full responsibility for the accuracy and quality of the tools and equipment that he is furnishing.

How Can We Accelerate the Armament Program?

By ROBERT T. KENT

This article, containing definite constructive suggestions for the acceleration of the Defense Program, is written by a man whose training and experience give authority and weight to his ideas. Robert T. Kent has, for the past year, been advisory engineer of the Ordnance Department of the U. S. Army, a position from which he resigned October 8. Prior to taking up his work with the Ordnance Department, he was general manager of William Sellers & Co., Inc., Philadelphia, well-known builders of heavy machine tools. During the last war, he was consulting engineer to the Niles-Bement-Pond Co., also a prominent builder of heavy machine tool equipment. He is the author and editor of the present "Kent's Mechanical Engineer's Handbook."

The *New York Times* for October 24 carried a headline: "Army Tank Program Doubled." Similar headlines appeared in other newspapers all over the country. The present program represents a considerable increase in the original schedule of tank production, which already has put a severe strain on the machine tool industry. Raising the schedule to 2000 or 3000 medium tanks per month, as has been variously reported, introduces problems of machine tool supply that surpass any heretofore encountered; and tanks are only one item in the tremendous amount of equipment necessary to supply a modern army and its allies.

To accomplish the objectives, it will be necessary to scrap many previously conceived ideas as to methods and adopt new and simpler ones. The Canadians have the answer: Special, single-purpose tools, designed for the job, to be operated by unskilled labor; parts for these machines to be made in every job shop in the country, assembled in larger shops, and scrapped when the emergency is over; and last, but far from least, adequate horsepower for the machines to enable them to take the heaviest cuts the work will stand, and sufficient rigidity in the machines to resist the stresses set up by the heavy cuts.

Have we been doing this in the United States? We have not. The various contractors for army equipment have outlined the equipment required in terms of standard machine tools, and then have sat down and waited until those tools could be delivered. Only in relatively few instances have the contractors been willing to listen to suggestions for special, single-purpose tools, and to arrange for having them built. The majority have insisted on standard tools with a multiplicity of feeds and speeds, 75 per cent of which would be useless on the job for which the machine was to be used. In consequence, the Defense Program is at least six months behind where it could have been, had intelligent foresight been used and reasonable pressure exerted on the contractors and the machine tool builders.

It will serve no useful purpose at this time to ask why this condition has been allowed to exist. The responsibility can be divided between the contractors, the Army, the Administration, the machine tool builders, and the law of the land. It will be more to the point to outline the constructive steps that can be taken from now on to obtain the necessary production. Some of these steps are outlined below.

1. Abandon the use of precision tools for roughing work, and use them only for the final finishing cuts where close tolerances must be maintained.

2. Build, for roughing work only, tools of limited precision, with sufficient rigidity and horsepower to hog off all excess metal down to the finishing cut in one operation.

3. When a standard machine tool is unavailable for a job, use a substitute tool or build a single-purpose, special machine to do the work, equipped with only the feeds, speeds, and attachments necessary to complete the job for which it is designed. Such machines should be built for both roughing and finishing.

4. If necessary, so amend the law that the Army can compel a contractor to equip with special tools instead of waiting for standard tools. This power of compulsion exists in Canada.

5. Divide the work of building both special tools and armament items among a large number of shops, each of which can make one or

more parts. These parts then can be brought to central assembly plants.

6. If necessary, so amend the law that prime contractors on any munitions contract can ship surplus parts of their product to other prime contractors who may be short of such parts.

7. Change the habits of thought of all concerned to the end that when a new or novel method of accomplishing an objective is proposed, a determined effort will be made to find a way to make the method work, instead of trying to discover all the reasons why it will not work.

A brief discussion of the foregoing is in order.

Precision Machines Should Not be Used for Roughing Work

It is a serious waste of machine tool capacity to use precision tools for roughing work. One of the most acute bottlenecks in machine tools is the horizontal boring, drilling, and milling machine. A 5-inch spindle, table type machine costs, fully equipped, in the neighborhood of \$30,000. Nearly one-third the cost of this machine is incurred in the building into it of the last two ten-thousandths of an inch of accuracy. Yet, in a great many shops all over the country, this high-precision machine can be observed taking roughing cuts 3/4 inch deep, where the limit of accuracy is plus or minus 1/16 inch. Were this roughing work done in separate machines, within a limit of plus or minus 1/32 inch, we probably would find that we have in the country today ample horizontal boring machine capacity to perform all the finishing operations called for by the Defense Program.

As an example, last summer, a machine tool builder was far behind in his deliveries. An investigation of his plant revealed that his principal trouble was lack of boring capacity. He was using his horizontal boring machines for both roughing and finishing work. Within half a mile of his plant was another plant equipped with horizontal boring machines, not quite so accurate, that was running one shift, five days a week. The second plant expressed its willingness to put on second and third shifts, and to undertake rough-boring for the first plant. This would, at least, have doubled the output of the plant that was in difficulties.

What happened? Nothing. The manufacturer was satisfied to continue as he was, and neither the Army nor the O.P.M. had the power to compel him to sub-contract his work. Meanwhile, the production of various vital munitions was held up, awaiting delivery of this manufacturer's machines.

The foregoing example could be multiplied a hundredfold in munitions plants—for example in shell production. Some manufacturers are using standard machine tools adapted for shell work. Others are using special lathes that perform several operations at one time, the length of the cycle being the time of the longest operation. The Canadians have developed special-purpose, single-operation, roughing and finishing machines for shell work. Any one of the shell plants in Canada that the writer has visited excels in production the average plant in the United States.

More Power Required for Heavy Cuts

The writer's experience over a long period of years, both in building and using machine tools, has convinced him that the average standard machine tool is under-powered—that is, it has neither the horsepower nor the rigidity to take full advantage of the cutting ability of high-speed steel or of the tungsten and tantalum carbides. In the production of armament in the present emergency, this is very serious.

For example, a certain standard tool was observed in a shell plant adapted to the rough-turning of shells. Four turning tools were in operation, but at speeds and feeds that were far too low. A suggestion that both be increased met with the response that the machine would not pull the additional load. The machine had a 20-H.P. motor, whereas a rough calculation showed that about 32 H.P. was required at the points of the tools for maximum production. A 40-H.P. motor was suggested, but the reply was made that this had been tried, with a resultant stripping of some driving gears. The solution in this case would be the use of special machines for roughing shells, of such power and rigidity that the complete removal of metal from the rough forging down to the finishing cut could be accomplished in one operation.

Special-Purpose Roughing Machines Can be Built Cheaply

The same consideration applies to nearly all other operations, especially rough-boring, planing, milling, and rough-turning. Machines for such work can be built at low cost, capable of doing work to within plus or minus 1/32 inch, and with ample horsepower and strength to rough work in one cut. Expensive finishing operations in their construction, such as scraping, can be eliminated.

The mating surfaces, as they come from the finishing cut on the lathe, planer, or milling machine, will be plenty good enough for a roughing job. They can be turned out in half the time required to build a precision machine, and time is the most important factor in our economy today. Furthermore, by producing such machines, the machine tool industry will be doing itself a

distinct service. These machines will not outlast the emergency. Every one of such machines built today will reduce, by the same amount, the number of standard tools left to glut the second-hand market after the emergency is past.

Tanks offer a splendid example of the possibility of using special-purpose tools or substitute machines. The new design of medium tank calls for a turret on top of the hull. To machine the bottom of this turret and the rings for the ball-bearing races, 450 standard 10-foot vertical boring mills were stated to be necessary for a production of 1000 tanks per month. These machines should be available in April, 1942.

Even if the machine tool builders who regularly build these machines had no other orders on their books, the production of 450 standard 10-foot mills in the time available is a physical impossibility. Machines of this kind require three to five months to build, from the time the patterns are put in the sand to the time the motors and controls are connected. And the newspapers of October 24 say that the increased schedule is to be not 1000, but 2000 to 3000 tanks per month! Where are the boring mills to be obtained, to say nothing of the other tools? It is very easy to write a schedule of 3000 tanks on paper, but some planning is necessary to transform this schedule into shooting tanks.

Solving the Problem of Tank Production with Simple Machines

Again, the answer is special tools. A design is available of a very simple vertical boring mill that can be built in less than three months; this machine will have only the movements necessary for the job to be handled and will have the simplest type of drive. Further, it need not tax any of the existing machine tool building capacity, because it can be built in shops that are being shut down by priority orders.

Proper planning to ferret out all the shops that can take on parts of this program would enable the Government to have these machines flowing to the tank builders early in 1942 at the rate of 40 to 50 a week. It is proper here to ask the question, "Is this planning being done, and is a simple machine to be adopted, or is there to be a continuation of a futile effort to obtain standard tools?"

Numerous other examples could be cited of how special tools would enormously expedite production, not only of tanks, but of guns, gun carriages, small arms, ammunition, and all the other items needed by the Army. Enough has been said, however, to show what can be done if there is determination to get it done.

Let us now examine for a moment the possibility of employing substitute tools, again using tanks as an example. The hull of the new design of medium tank is a one-piece steel casting, approximately 16 feet long, 8 feet wide, and 4 feet high. It is machined along the bottom edge, around the entire periphery, to a tolerance of plus or minus 1/32 inch. This work is being done today in a floor type horizontal boring, drilling, and milling machine, the casting being set on its side, facing the machine. There are relatively few machines of this type in the country with sufficient horizontal and vertical travel of the head to handle a casting of this size. The time required to build such a machine is about four months, and there does not exist today sufficient capacity to build the number required for a 2000 per month tank program in less than two years.

There are, however, scattered throughout the United States upward of 1000 stone planers of such size that they could easily handle a tank-hull casting, and of sufficient power to machine armor steel. While not the most accurate machines in the world, they still can operate to tolerances far closer than plus or minus 1/32 inch. These planers not only could do the job more quickly than the horizontal machine, but they are today standing idle. Query: "Why not put them to work and thus avoid the delay and expense of new machine tools?"

There are a great many small machine shops, and many large ones, throughout the country that are literally crying for work. Some of these shops can do work of the highest precision; others can do only rough work. Some are equipped to make 50 per cent of the parts that enter into a completed machine or product; others are equipped to make only one or two parts. But by putting them all to work, each making the parts it is fitted to make, the productive machine-hours would be tremendously increased.

Some will argue that these little shops cannot do the character of work that our products require. The answer is that they can very quickly be taught to do it. The irrefutable argument to the statement that a given thing cannot be done is that it *has* been done. The writer knows from personal experience that machine work of the highest precision can be farmed out, and also that the non-precision shop can be taught how to do precision work. There is a vast pool of unutilized machine-hours available in the United States today. Why not make use of it?

In Some Cases Foolish Legislation Stands in the Way

There exists a curious regulation or law that prohibits the diversion of the property of the United States to any civilian agency or corporation. Under certain interpretations of this law, any material upon which work has been done

under a contract with the United States, and for which payment in full or in part has been made, becomes the property of the United States. This interpretation has operated in the past and may operate again to delay production of defense equipment.

For example, no one of a group of manufacturers of an identical piece for a badly needed defense product was able to get into production for several months because each one of the group was short of the machine tools necessary for making one or another of the components of the piece in question. Collectively, the group had the machine tools to make all the components. At a meeting of the group, the very sensible conclusion was reached that they all should go into 100 per cent production with the equipment they had, each one making the components he was equipped to make. Each manufacturer then would ship his surplus to the others, thus enabling all of them to start assembly of the complete piece.

The plan was blocked by legalistic-minded persons in Washington, who pointed out that to follow out the plan would involve diversion of the property of the United States, which would be a violation of law. The fact that the diversion would be from one United States contractor to another, and that eventually the United States would come into possession of all the so-called diverted property, made no difference. There was the law. Finally, an executive order was obtained, permitting the exchange of components between the several manufacturers. But so much time had been lost in the meantime that the manufacturers had all obtained their tools and were in production before they received permission to exchange surpluses.

Get Rid of that Mental Inertia

The incident just related brings us naturally to the last suggestion—changing our habits of thought. Mental inertia probably is delaying defense as much as deficiencies in machine tools. Not only in Washington, but throughout industry is the tendency, unconscious perhaps, to regard the new, the untried, or the unconventional as impossible, and to find reasons why it should not be done or even attempted. The discovery of only one way to do an impossible job knocks out one million reasons why it cannot be done. The man who avers that a thing cannot be done is confessing to one thing only — he, himself, does not know how. Some other man may, and probably does, know.

There exists today in these United States the man power and most of the machine power to put over the Defense Program. There is needed only one more element—*the will to do it.* Wake up, America!

Gallup Poll on the Closed Shop

At a time when closed shop demands are being pressed by union leaders in almost all industries, it is of interest to note what the general public thinks of the closed shop. As a fact-finding organization devoted to public opinion research, the Gallup Institute has conducted a survey to determine where the public stands on the closed shop issue. According to Dr. George Gallup, the results indicate that labor union leaders have thus far not been able to win the support of public opinion for closed shop demands. Men and women interviewed in the poll — voters representing an accurate cross-section of the nation—are opposed to the closed shop by a ratio of approximately 6 to 1.

A comparison with the results of earlier polls on the same issue shows that the closed shop has less public support today than it has had in recent years. For example, in June, 1937, 28 per cent of those interviewed favored the closed shop, 59 per cent opposed it, while 13 per cent expressed no opinion. Today, only 13 per cent expressed themselves in favor of the closed shop, 77 per cent opposed it, while 10 per cent were undecided.

According to Dr. Gallup, the decline in sympathy for the closed shop follows the general trend of sentiment toward labor union leadership. While the Institute has found that the great majority of voters support the right of workers to join unions, there is, nevertheless, a decline in public sympathy for organized labor under the leadership of the past few years. Quoting from Dr. Gallup: "It is not necessary to talk to many voters in order to discover what is the most typical and the most widespread objection in the mind of the American public to the closed shop. Briefly, it is this—the closed shop takes away the right of the worker to decide whether he wants to belong to a union. No one should be forced to join a union. That is not the American way of doing things."

* * *

Lubricant for Lathe Centers

The use of concentrated Oildag, a product made by the Acheson Colloids Corporation, is said to reduce materially the wear on lathe centers. The Oildag is smeared on the centers, the same as white lead would be. The colloidal graphite, which is the basis of the lubricant, forms a graphoid surface on the lathe center. This surface not only has a high lubricating value itself, but also has greater affinity for oil than the metal surface of the lathe center. Lathe center wear has become more and more of a problem lately, because of the increased speeds in machine tool operation.

TYPICAL APPLICATIONS OF SAE STEELS—5

This listing, based on the 1941 SAE classification of steels, is not intended to be complete, but rather to indicate by typical examples what steels are suitable for various types of applications.

Crankshafts

Medium-carbon steel No. 1040 with fair machining properties and deep hardening characteristics is suitable for small and medium-sized plain carbon-steel forgings.

Medium-carbon steel No. 1045 is intended for larger sizes of plain carbon-steel forgings.

Medium-carbon steel No. 1050 is intended for larger sections than steel No. 1045.

Nickel-chromium steels Nos. 3135 and 3140 are used where good physical properties are required.

Nickel-chromium steel No. X3140 has a higher chromium and manganese content than steel No. 3140, and is used where improved hardening characteristics are desired for parts of larger section.

Chromium-nickel-molybdenum steel No. X4340 is used for Diesel engine crankshafts.

Chromium alloy steel No. 5140 may be used interchangeably with steel No. 3140 for heat-treated forgings requiring greater strength and toughness than are obtainable with plain carbon steel.

Cutlery

Stainless chromium iron No. 51335 is capable of heat-treating to a relatively high hardness.

Coulter Blades

See Agricultural Machinery Parts.

Cultivator Disks

See Agricultural Machinery Parts.

Deep-Drawn Parts

Low-carbon steels 1010 and 1015 have many applications for deep-drawn parts in the automotive field.

Low-carbon steel No. X1015 has improved machineability and hardening properties, due to its manganese content.

Chromium-nickel austenitic steel No. 30905 is recommended for deep drawing where corrosion resistance plus maximum softness and ductility are required.

Chromium-nickel austenitic steel No. 30915 is a higher carbon type than steel No. 30905, and is recommended for parts that must show a slightly higher tensile strength.

Drag Links

Low-carbon steel No. 1020—a standard carburizing grade.

Low-carbon steel No. X1020, a higher manganese variant, has improved machining and hardening properties, as compared with steel No. 1020. It carburizes and hardens freer from soft spots.

Drawn Shapes (Not Deep Drawn)

Low-carbon steel No. 1020 may be drawn into various shapes, but is not as desirable for deep drawing operations as steel No. 1010.

Fan Blades

Low-carbon steel No. 1020—a standard carburizing grade.

Low-carbon steel No. X1020 has improved machining and hardening properties compared with steel No. 1020. It carburizes and hardens freer from soft spots.

Fender Stock, Automobile

Low-carbon steels 1010 and 1015 provide excellent surface finish, and are suitable for deep drawing.

MACHINERY'S Data Sheet No. 455, December, 1941

TYPICAL APPLICATIONS OF SAE STEELS—6

This listing, based on the 1941 SAE classification of steels, is not intended to be complete, but rather to indicate by typical examples what steels are suitable for various types of applications.

Forgings

Low-carbon steel No. 1020 for parts where high strength is not essential. Not recommended for smooth threading, turning, or broaching. Does not respond materially to heat-treatment unless carburized or cyanided.

Low-carbon steel No. X1020, a higher manganese variant, has improved machining and hardening properties compared with steel No. 1020. Carburizes and hardens freer from soft spots.

Low-carbon steel No. 1025 forgings machine better without annealing or by simple normalizing. Not regarded as casehardening type, but suitable where core hardness is desired or for large sections.

Low-carbon steel No. X1025, a higher manganese variant, has improved machineability and physical properties compared with steel No. 1025.

Low-carbon steel No. 1030 is used for forged, machined, or cold-worked parts requiring higher physical properties than are obtainable in the lower carbon steels. It machines satisfactorily either without annealing or by a simple normalizing. Suitable for casehardening where core hardness is desired or for large sections, but does not come within carburizing steel classification.

Medium-carbon steel No. 1035 is a fair machining steel for small and medium-sized forgings requiring moderate physical properties.

Medium-carbon steel No. 1040 is suitable for small and medium-sized plain carbon-steel forgings.

Medium-carbon steel No. 1045 is intended for the larger sizes of plain carbon-steel forgings used in automotive construction, such as crankshafts, etc.

Medium-carbon steel No. 1050 is intended for parts of larger section than steel No. 1045.

Free-machining steel No. X1330 may be substituted for steels Nos. 1035 and 1040 in many cases, where improved machining, deeper hardening, and higher physical properties are desired.

Nickel-chromium steels Nos. 3135 and 3140 are used for a great many heat-treated structural parts where good physical properties are required.

Nickel-chromium steel No. X3140, a higher chromium and manganese variant of steel No. 3140, is used where improved hardening characteristics are desired for parts of larger section.

Nickel-chromium steel No. 3240 is intended for heat-treated forgings and machined parts subject to severe service conditions and demanding greater strength than is obtainable with similar steels of lower alloy content.

Nickel-chromium steels Nos. 3245 and 3250 are intended for oil-hardened parts requiring very high physical properties.

Molybdenum steel No. 4140 is used in forgings for aircraft parts.

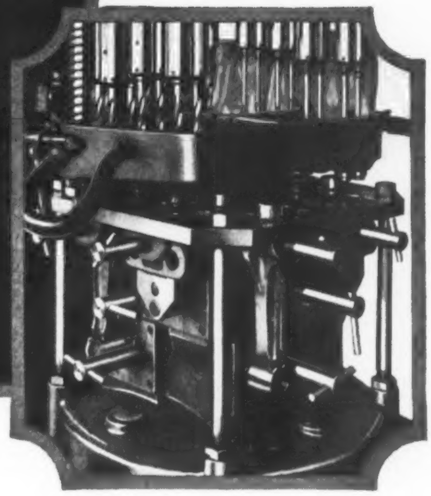
Chromium alloy steel No. 5140 may be used interchangeably with steels Nos. 2340 and 3140 for heat-treated forgings requiring greater strength and toughness than are obtainable with carbon steel.

Chromium-vanadium steel No. 6150 is suitable for heat-treated forgings and machined parts subject to severe conditions, where high strength and anti-fatigue properties are essential.

Chromium-nickel austenitic steel No. 30615 has only a limited application for forgings. This is a free-machining steel not capable of heat-treatment.

MACHINERY'S Data Sheet No. 456, December, 1941

Design of Tools and Fixtures



Device for Truing Form-Grinding Abrasive Wheel

By DONALD BAKER, Newark, N. J.

Hardened steel pins like that shown in Fig. 1 are required to have a flat spot ground at *A* after hardening. A formed groove *B* is then ground in the flat spot. The bottom of the formed groove must be ground to a radius of 3/8 inch and the edges must be ground to a radius of 1/8 inch, as indicated in the cross-section *X–X*. The largest grinding wheel that can be used for this work is 1 inch in diameter.

The diamond wheel-dresser shown in Fig. 2 was devised to form the abrasive grinding wheel to the required shape for the groove-grinding job. This dresser can be easily adapted for grinding other profiles by substituting a cam having the required form or profile for the one shown at *C*, and in detail in Fig. 3.

The base of the dresser is made of machine steel, pack-hardened and ground on the working or bearing surfaces. The sliding member *G* is held on the base by means of gibs *H*. Stop-screws *I* are placed in tapped holes in the ends of one of the gibs. The hardened and ground bushing *D* is pressed into place in a hole in slide *G*. A separate view of bushing *D* is shown in Fig. 4.

Plunger *K* is a free sliding fit in bushing *D*. It is held from rotating and is guided by a pin *L*

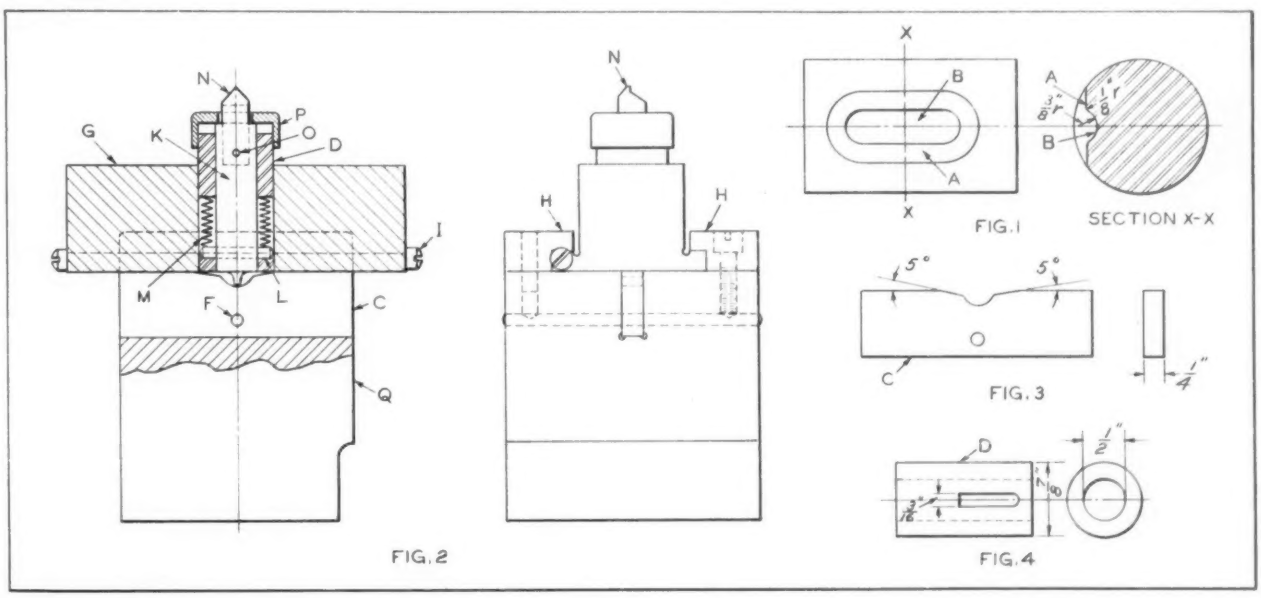


Fig. 1. Steel Pin with Flat Spot A and Groove B Ground after Hardening. Fig. 2. Fixture Used in Truing Wheel for Grinding Groove B, Fig. 1. Fig. 3. Cam C, Fig. 2, for Guiding Path of Truing Diamond. Fig. 4. Sleeve D, Fig. 2

which is free to slide up and down in the slots in bushing *D*, two springs *M* being placed in the slots over the pin so that the plunger is always held down on cam *C*. Truing diamond *N* is mounted in the top of plunger *K*. The diamond mounting is held in position by pin *O*. The dust cap *P*, pressed on the shouldered end of plunger *K*, is a sliding fit over the end of bushing *D*.

When the truing device is in use, face *Q* is placed against the locating jaw of the fixture in which the work is afterward held. This locates the truing diamond in its proper relation to the wheel to be dressed. The wheel is then brought down against the diamond, and slide *G* is moved backward and forward by hand, in order to dress the wheel to the correct shape, as determined by the shape of cam *C*, Fig. 3.

Clamping Device for Use in Tapping Cast-Iron Caps

By JOHN W. GERDEL, St. Louis, Mo.

Several thousand each of four different sizes of cast-iron caps of the design shown at *Z* in the accompanying illustration were to be tapped with 16 threads per inch, the diameters ranging from 1.14 to 2 inches. The heads of the caps were octagonal in shape. The first lots of the cap castings were cast from a gated pattern. When they came from the foundry, they varied in size to such an extent that an ordinary drill press vise would not center them with sufficient accuracy to bring them into alignment with the tap. It was to overcome this difficulty that the clamping device here illustrated was developed. This device holds the caps down on a flat surface and clamps them from two sides, so that each is brought into line with the tap regardless of variations in size. One of the caps is shown clamped in place at *W*.

The clamping device was built around a badly worn clamping head taken from a pipe-threading machine. This head consists of a cast housing *A* in which a slot is planed. Two blocks *B*, fitted in the planed slot, are operated by a right- and left-hand screw *C*. This screw is held in position by two plates *D*, and is used to adjust the fixture to hold different sizes of caps.

The two studs *E* are fitted in the blocks *B*. These studs act as fulcrums for the two cast-steel levers *F*, and are of such length that the nuts can be tightened without interfering with the action of the levers. A cam *H* and handle *I* are mounted on a stud *G*, fitted in the cast housing. The top projection of the cam is squared and the hole in the handle is made to fit this square. The cam is made of tool steel, and is hardened. The rise on the cam is the same on both sides, and is sufficient to allow for quite a variation in the size of the caps.

The clamping ends of the two levers *F* are milled to receive the V-shaped hold-downs *J*. The rear ends of the hold-downs are rounded to give them a slight floating action. The rounding (not shown in the illustration) is very slight, the total convexity being only 0.015 inch. They are of hardened tool steel, and are held in place by the shouldered studs *K*. The spring under the hold-downs serves to keep them slightly off the block *M* when they are in the idle position. Two hardened-steel strips *Q* are pinned in the levers to take the thrust of the hold-downs.

A cold-rolled steel strip fastened to a planed surface on the housing *A* is pinned to the hardened block *M* which acts as a table on which the caps are clamped. On the rear ends of the levers *F* are placed hardened-steel blocks *O* which take the thrust of the cam. These blocks are made of various thicknesses to keep the levers parallel, regardless of differences in the cap size.

The device is mounted on a 20-inch drill press table. In operation, the cap is placed on block *M* and the handle *I* is forced to the left until the cap is properly seated. The thread is then tapped in the cap. After being tapped, the cap is released by pulling the handle to the right. The cap is then removed, the table cleaned, and the next cap placed in the device.

Easy Way to Memorize Some Shop Calculations

By WILLIAM S. ROWELL, Wilkinsburg, Pa.

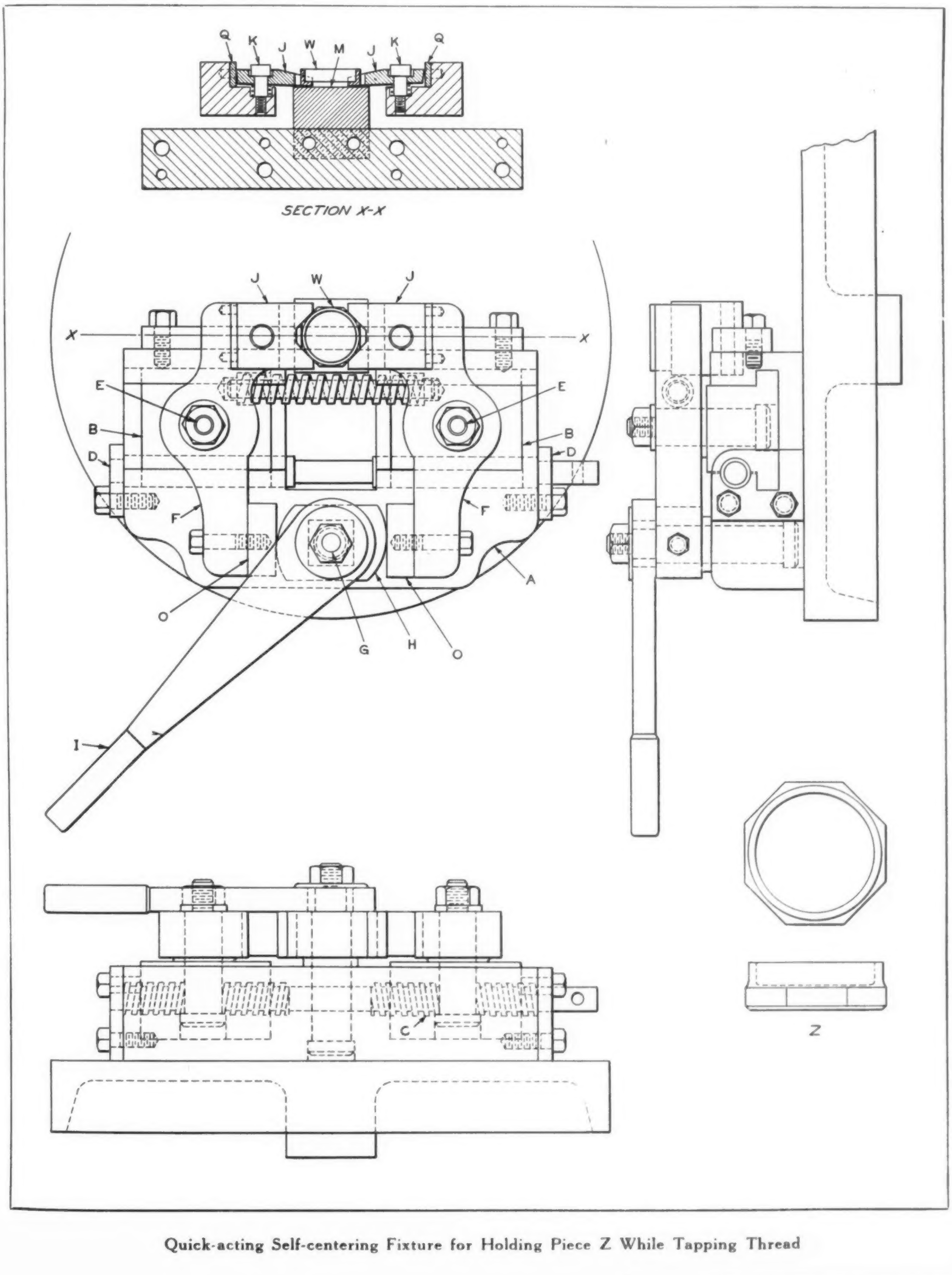
Below are given rules for quickly obtaining tap drill sizes and the feed of a compound slide when cutting threads of angular section.

The tap drill size, when a full thread is wanted, is equal to the nominal outside diameter of the tap less the double depth of the thread. No one can carry in his head the value of the double depth of all pitches, but it is easy to remember the double depth of a 1-inch pitch thread, which, in the case of American National threads, is 1.29904 inches. For convenience, this may be called 1.300 inch and used as a constant. From this, the double depth of any thread is easily computed. *Example:* The double depth of 13 threads per inch equals $1/13 \times 1.300 = 0.100$.

The movement or feed of a compound slide for cutting any thread of angular section with the compound slide set at one-half the included angle of the thread is readily obtained by a similar method. We use the length of the angular side of a 1-inch pitch thread as a constant. This length (American National thread) is

0.750 inch. From this we readily obtain the length of the angular side of any American National thread. *Example:* For 13 threads per inch, the length is $1/13 \times 0.750 = 0.0577$.

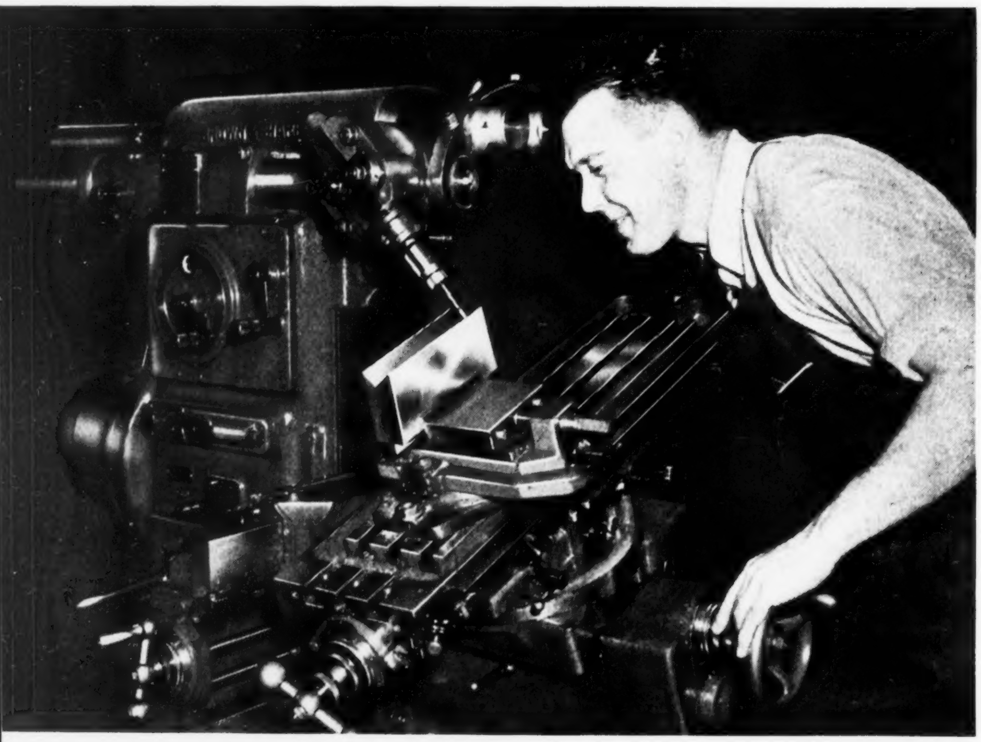
It is obvious that the outside diameter of the work and the flat point of the tool should be very close to the exact size if accurate screws are to be cut to size by this method.



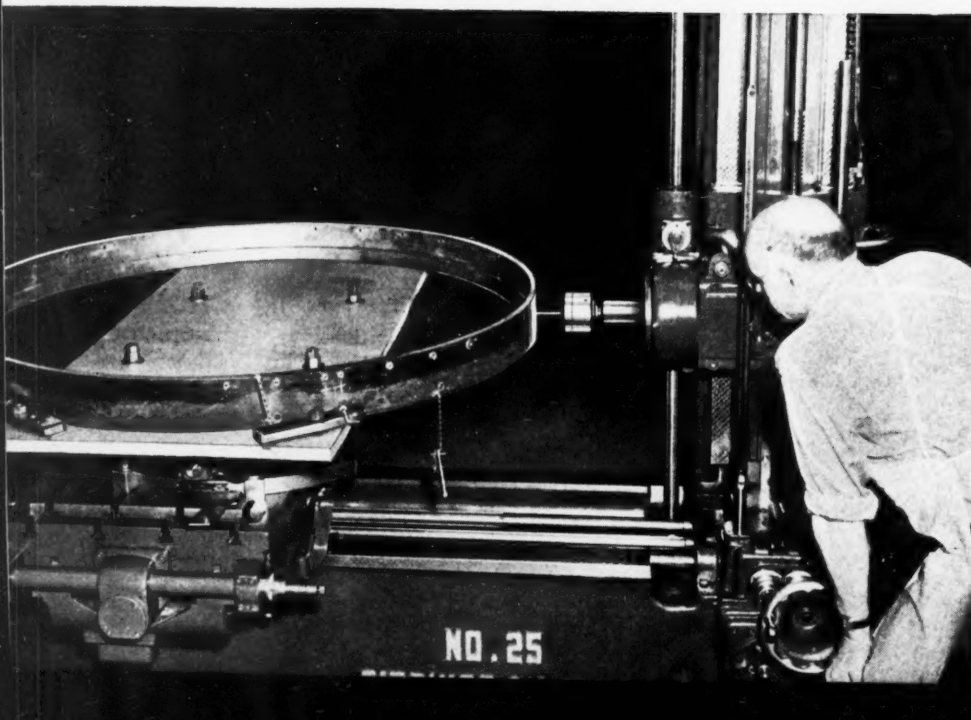
Quick-acting Self-centering Fixture for Holding Piece Z While Tapping Thread

Modern Machines
Jigs and

Cutting a Two-inch Thick Piece of Duralumin Plate for a Wing Tip Die to an Irregularly Scribed Outline on a DoAll Contour Machine. An Internal Outline is being Sawed after the External Contour has been Cut. The Table is Tilted at an Angle of 6 Degrees 15 Minutes to Obtain a Taper Cut

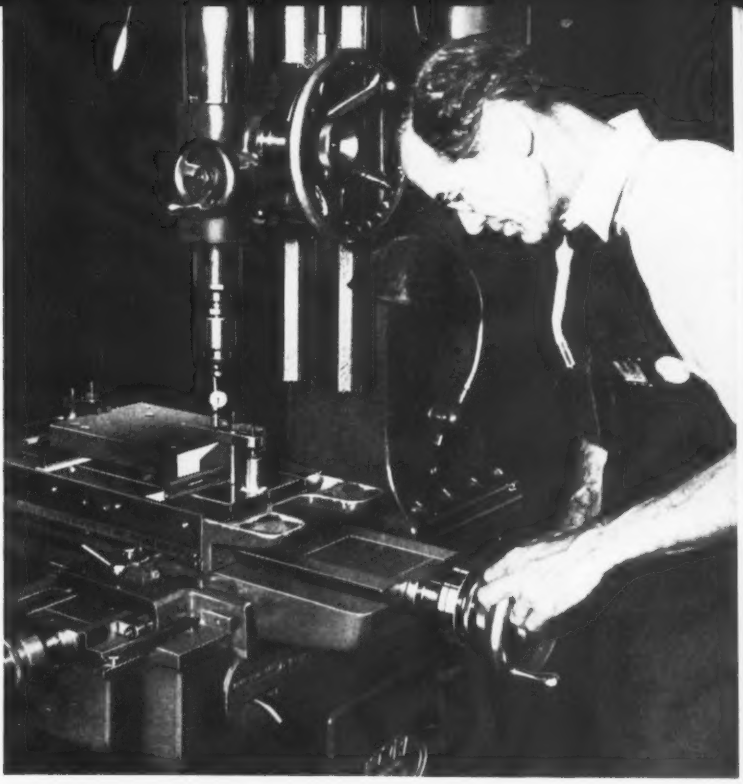


Milling Relief on the Ends of a Vee in a Steel Die-block with the Cutter-head Tipped at the Angle of the Vee and the Work also Tilted at an Angle. Use is being Made of a Brown & Sharpe Omniversal Milling Machine, which Can be Set at Compound Angles

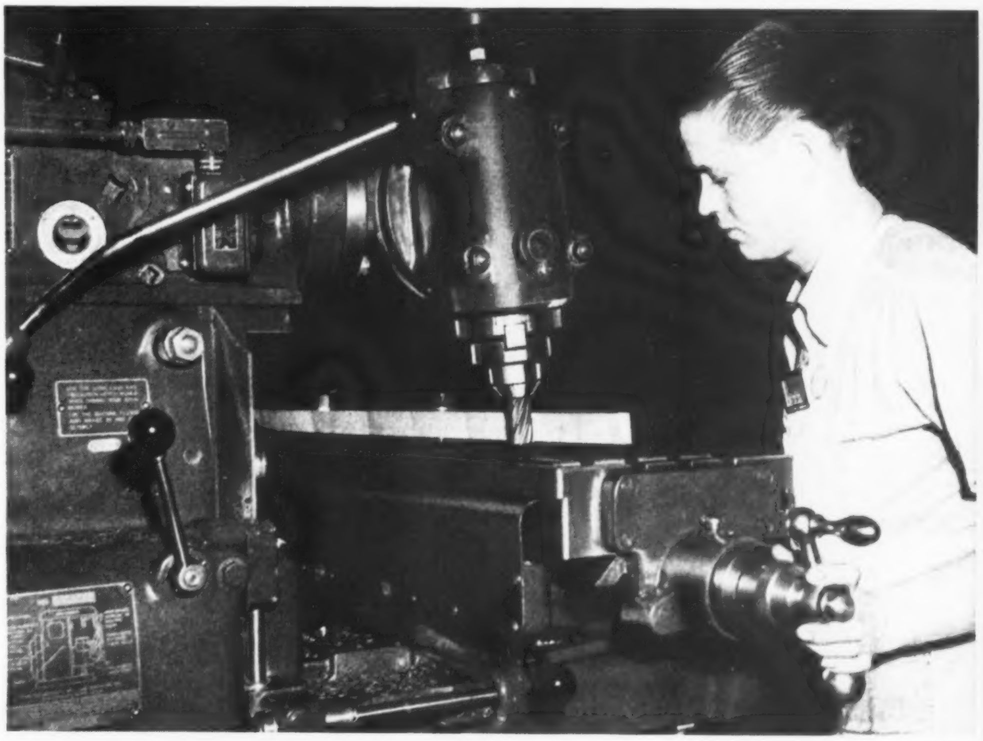


Jig Boring Operation being Performed on a Giddings & Lewis Horizontal Boring, Drilling, and Milling Machine in the Toolroom of the Vega Airplane Company, Burbank, Calif. Thirty-two Holes Ranging from 1/4 to 3/4 Inch in Diameter are being Accurately Drilled and Bored around a 58-inch Jig Ring, to Receive Guide Bushings

Produce Vega's Fixtures



Inspecting the Accuracy of a Steel Die-block in the Tool-room of the Vega Airplane Co. by Employing a Dial Indicator Attached to the Spindle of a Moore Jig Borer. The Inspection Consists of Checking Location and Diameter of Eleven Holes of Various Diameters, and Dimensions of a Long Slot



Finishing the Irregular Surfaces of the Wing Tip Die Member on a Cincinnati Milling Machine Equipped with a Universal Head on the Over-arm. The External and Internal Surfaces are Milled Completely around the Duralumin Plate, which is 3 1/2 Feet Long

Jigs of Welded Tubular Construction are Used Exclusively in the Sub-assembly and Final Assembly of Plane Parts by the Vega Airplane Co. This Illustration Shows Welded Pads of a Tubular Jig Member being Machined by Employing a Cleveland Open-side Planer. The Work is Approximately 4 Feet Square Over-all

Automatic Control of Boring Mills

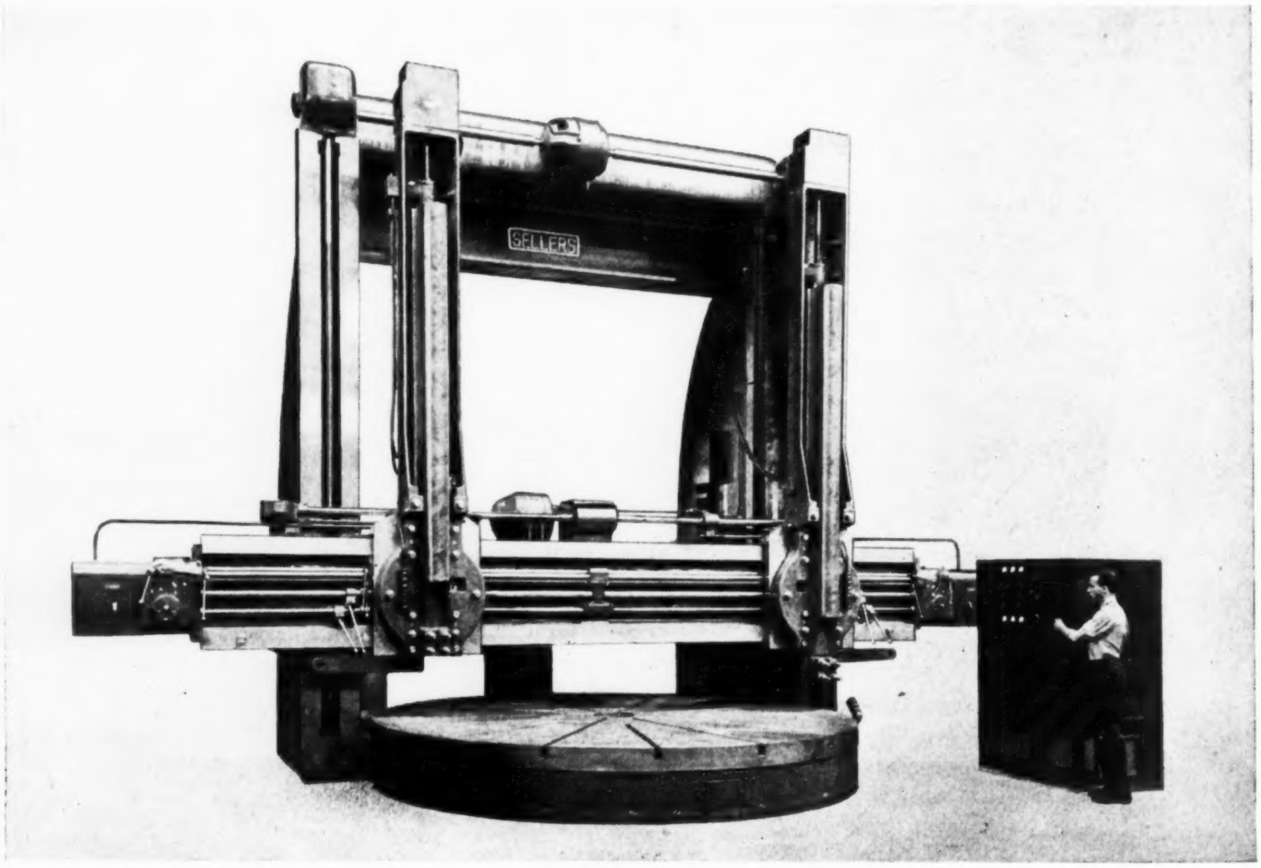


Fig. 1. Boring Mill with 14-foot Table Arranged for Precision Control of Saddle and Ram through Selsyn Dial Controls and Precision-cut Lead-screws

By R. HILLNER, Turbine Department
and K. K. BOWMAN, Consulting Engineering Laboratory
General Electric Co., Schenectady, N. Y.

AUTOMATIC precision controls have been applied to two large boring mills, by means of which it is possible to set up the machines for a predetermined cut in feet, inches, and thousandths of an inch, and have the tool automatically take this cut and stop within 0.002 inch of the indicated position anywhere in a total distance of about 10 feet. These machines, shown in Figs. 1 and 2, are being used in the turbine department of the General Electric Co., Schenectady, N. Y., for machining steam turbine shell castings. Although the electrical systems of control used on these machines are dissimilar, and each offers individual advantages, the cutting accuracy of both boring mills depends upon precision-cut lead-screws. In order to obtain lead-screws of the required accuracy, it was necessary to employ the novel thread-cutting methods described subsequently in this article.

The nozzle and diaphragm joints of the turbine shells, such as shown in Fig. 3, must be machined to exceptionally close tolerances. The step recesses in work of this kind are difficult to machine, and much time has been consumed in the past in handling this kind of work on boring mills with conventional equipment. It was with the object of overcoming this difficulty that the precision control equipment, by which the horizontal as well as the vertical movements of the saddle and ram are controlled, was incorporated in the two mills.

Each of the machines shown has its own advantages. The saddle and ram of the first machine to be developed are accurately positioned by means of a Selsyn controlled torque amplifier

Obtained by Accurately Cut Screws

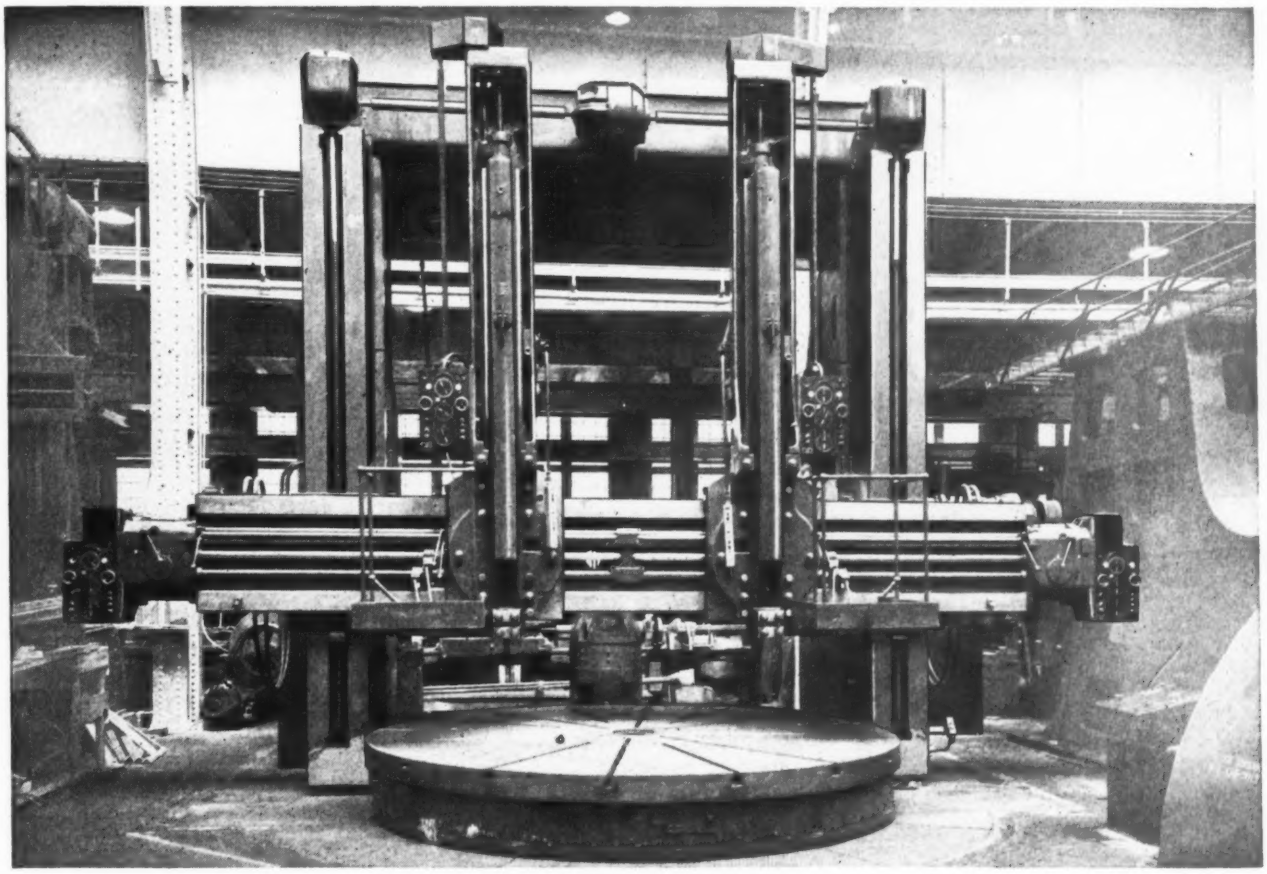


Fig. 2. Boring Mill with 14-foot Table Arranged for Precision Control of Saddle and Ram through Mechanical-drive Dial Controls and Precision-cut Lead-screws

system and a set of precision-cut lead-screws. The Selsyn controlled torque amplifier system is mounted on a control panel on the floor to the right of the machine, as shown in Fig. 1. The chief advantage of the Selsyn control is that it offers a system of remote control that is not obtained in the second machine, the control operations all taking place at the control panel. The second machine, Fig. 2, has its control equipment built into the ram and saddle, and is therefore less complicated to build, service, and operate.

The automatic precision control used on the machine shown in Fig. 1 can be divided into three main parts: (1) The measuring or positioning unit; (2) the control unit; and (3) the thyratron amplifier. The positioning unit contains two Selsyn receivers, one Selsyn generator, one Selsyn differential generator, and the necessary gearing.

The precision screw is geared to the operating screw, and each screw passes through nuts in the tool carriage. However, the precision screw is capable of axial movement in its bearings. This movement is a result of irregularities in the operating screw. Hence, by the addition or subtraction of a function of the axial movement of the precision screw to or from a function of its rotational movement, the tool location can be determined.

The high-speed Selsyn receiver is geared to the precision screw so that it will make one revolution for each revolution of this screw. The low-speed Selsyn receiver is geared to make one revolution for each 10 inches of tool travel. The Selsyn generator is geared to make one revolution for 10 feet of tool travel. The Selsyn differential generator is geared so that its rotor turns as a function of the axial movement of the precision screw. Its movement, when added to or subtracted from that of the high-speed Selsyn, will thus give a very accurate indication of the tool position

The control unit contains two Selsyn generators, one Selsyn indicator, a pilot motor and its control for driving the generators, and the neces-

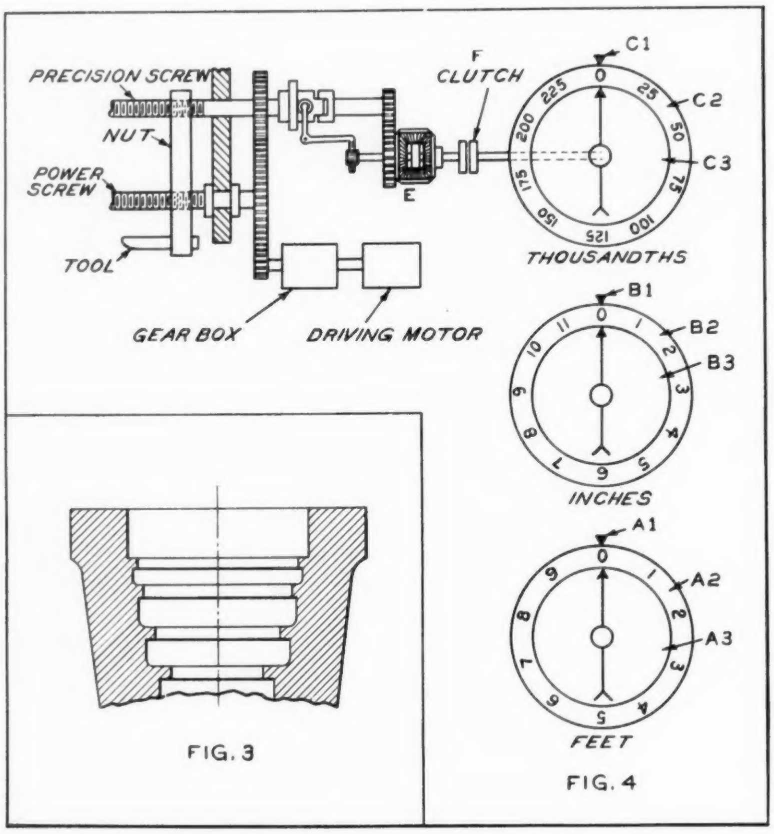


Fig. 3. Example of Stepped Work Machined to Exceptionally Close Tolerances on the Boring Mills Shown in Figs. 1 and 2. Fig. 4. Elementary Functional Diagram for Machine Shown in Fig. 2

sary gearing. The pilot motor speed is variable over a 9 to 1 range by both field and armature control. As a tool-feed variation of from 0.0048 inch per minute to 3.4 inches per minute, or a ratio of approximately 710 to 1, is required, three gear changes are necessary, in addition to the 9 to 1 pilot motor speed range, in order to cover the complete speed range. An additional gear change gives a traverse speed of 70 inches per minute.

The thyratron amplifier merely furnishes power to the feed motor in accordance with the grid signal furnished by the Selsyn receivers in the positioning unit. The magnitude of this signal depends upon the difference between the desired tool position and the actual tool position. The feed motor will receive sufficient power to hold this difference to a very small value. Any increase in the difference greatly increases the power supply to the feed motor to reduce the difference.

In operating the first machine developed, the primary step is the establishment of a reference mark. With a tool set on this mark and the automatic control energized, the adjustable index for each of the three dials is set at zero, indicating that the tool is in the zero position. Next, the ring dial unit of each dial is set for the distance the tool is to travel from the zero position. The dials, which are driven by a pilot motor, carry switches operated by means of cams on the ring dials. With the thyratron switch in the "on" position and the gear shift set for the desired speed, the cut is started by pressing the feed button.

As the stopping position is approached, the switch on the dial that makes one revolution for 10 feet of cutter travel opens. This reduces the speed of the pilot motor. It also sets the control so that when the switch on the dial that makes one revolution for 10 inches of cutter travel is opened, the speed will again be reduced. Then, when the stopping position is reached, the switch on the dial that makes one revolution for 0.200 inch of tool travel is opened, stopping the motor. Since the position of the tool is a function of the position of the dials, the tool is stopped accurately at the point corresponding with the predetermined dial setting.

Interlocks are provided, so that the pilot-motor and the feed-motor gear shifts must both be set for the desired speed. The pilot motor, and hence the tool feed, can be stopped at any time by means of a push-button. The traverse control buttons are of the momentary-contact type and are only effective when the traverse mechanism is in operation. The pointers of two meters provided on the controller are deflected from their zero positions only if an error occurs between the positions of the Selsyn receivers and generators. This arrangement provides a convenient check on the operation of the equipment.

The electrical system used on the machine shown in Fig. 2 includes: (1) An amplidyne generator, whose field is controlled to give a wide speed range of the feed motor of the machine; a conventional direct-current shunt-wound 1750-R.P.M. feed motor; (2) a pilot generator driven by the feed motor, and used as a speed indicating source; (3) the necessary devices to provide interlocking and to control the various functions.

The operating and precision screws of this machine are mounted as shown in Fig. 4, the same as in the case of the machine shown in Fig. 1. However, the axial and rotational movements of the precision screw are combined mechanically by means of differential *E*, Fig. 4, so that pointer dial *C3* shows the true tool position.

Operation is as follows: First, the operator

takes a reference cut. Then he releases the magnetic clutch *F* and sets the pointer dials *A3*, *B3*, and *C3* to the indices *A1*, *B1*, and *C1*. This is easily done, as dials *A3*, *B3*, and *C3* are geared together. Next the operator sets the desired stopping point for his next cut by moving ring dials *A2*, *B2*, and *C2* the desired amount. These dials are also geared together. With the gear shift and control handle set to give the proper rate of feed, he presses the button to give the desired direction of feed, which applies the field to the amplidyne generator, thus causing power to flow to the motor.

The speed at which the feed motor is to run depends upon a fixed voltage, the amount of which can be varied at will by the operator. The voltage of a small pilot generator driven directly by this motor is bucked against this fixed voltage through the field of the amplidyne generator. As the amplidyne generator requires an extremely small amount of field power, the motor speed will be such as to make the difference between the pilot generator voltage and the fixed voltage very small. By this means, a 70 to 1 motor speed variation by armature voltage control can be obtained with good load regulation.

As the tool nears the desired stopping point, a contact mounted on ring dial *A2* and operated by a cam on dial *A3* is opened. Then a similar contact on ring dial *B2* is opened by a cam on *B3* during the next revolution of *B3*. This gives a decreasing speed, and also opens the short circuit around another contact on dial *C2*. On the next revolution of *C3*, the latter contact is opened by a cam on dial *C3*. When this contact opens, the directional contactor is de-energized, disconnecting the control field from the power supply and connecting it across the motor voltage, thus bringing the motor rapidly to a stop.

There are duplicate switches and graduations on ring dials *A2*, *B2*, and *C2* to take care of the opposite direction of rotation. In the actual equipment as installed, only one gear change takes care of the complete range from 0.0005 inch per cut to 1/2 inch per cut. A control handle is provided by which any speed in a range of 70 to 1 can be selected without gear change. The amount of cut per revolution remains the same for any particular setting regardless of the variation in the table speeds.

Except for dial setting, the machine is operated the same, regardless of whether or not the automatic features are used, and if they are used, moving the screws manually will not change the accuracy of stopping. The dials can also be employed as micrometers without using the automatic features. Traverse at 70 inches per minute does not affect the dial settings.

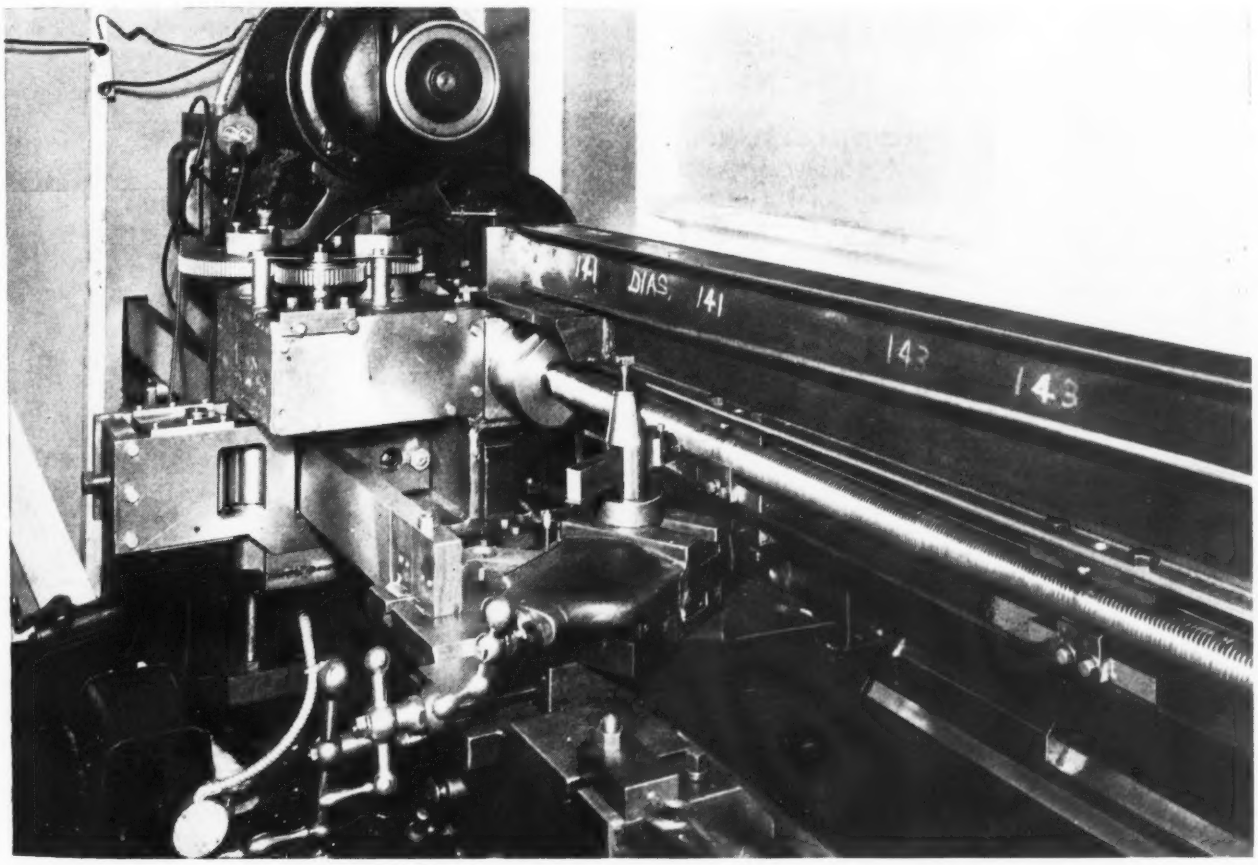


Fig. 5. Special Lathe Set-up Employing Roll and Bar Feed, Used in Cutting Precision Lead-screws for Boring Mill

This equipment has given satisfactory service since its installation in 1938, and hence has proved the practicability of the system. Its operation is so simple that the average boring mill operator requires only a few minutes instruction to enable him to handle the machine satisfactorily. The flexibility of control and the elimination of most of the usual boring mill gear shifts are important advantages.

In an effort to obtain lead-screws for the equipment described from manufacturers of precision screws, the best guarantee of accuracy obtainable indicated a lead error of plus or minus 0.0005 inch per foot. The screws used on the boring mills are 13 feet long, and a lead error of plus or minus 0.0005 inch per foot might result in an accumulated error of 0.0065 inch in the length of the lead-screw. This was considered excessive, and accordingly, the turbine department of the Schenectady Works decided to make the precision screws.

A reconditioned engine lathe was especially equipped, as shown in Fig. 5, for cutting the screws. This lathe was placed in a temperature-controlled enclosure. A very accurate single-thread worm was mounted concentrically on the lathe spindle nose for driving a worm-wheel. On the end of the worm-wheel shaft was mounted a precision gear which drives the friction feed-rolls. The lathe carriage was driven by the friction feed-rolls through a carefully machined and ground rectangular bar, 1 3/4 by 5 3/4 inches by 14 feet long.

The lathe feed-bar was supported by rollers to assure accurate alignment and prevent sagging. As the precision screws to be cut have five threads per inch, the gearing was so arranged that the lathe carriage traveled a distance of 1/5 inch in one revolution of the spindle. The body of the lead-screw was suspended under a 12-inch reinforced I-beam that extends the whole length of the lathe bed. Screw guiding shoes were placed 24 inches apart and fastened to the I-beam in order to steady the screw being cut and to prevent it from sagging.

The lathe carriage was carefully counter-weighted, so that the feed-bar was required to overcome only a minimum of resistance. This method of cutting precision screws produced good results, the accumulated error in the 13-foot screw lengths at a temperature of 72 degrees being less then 0.001 inch.

American Gear Manufacturers' New Standard Speeds for Gearmotors

THE American Gear Manufacturers Association has recently announced a new standard speed program for Gearmotors. In working out this new program, the committee found that standard speeds were but part of the task, and that it was equally important to adopt some uniform method of rating, so as to eliminate the differences of opinion on the reserve capacity required for given selections. This called for a practice on the rating and selection of Gearmotors, and a "Proposed Recommended Practice for Gearmotors" was worked out and adopted in October, 1940, by the Association. At the same time, the standard output speed program was adopted by the National Electrical Manufacturers Association and recommended to the Gear Association for favorable action, which made it possible for the latter association to adopt this part of the program along with the rating practice.

The new standard output speed program was selected with a series factor of 1.225, using 1750 R.P.M. as the base. This means that the next lower speed is 1750 divided by 1.225, or 1430 R.P.M. The next lower output speed is then obtained by dividing 1430 by 1.225, which is 1170 R.P.M., and so on. Therefore, each output speed is a multiple of the factor 1.225, with 1750 representing the starting point and with actual numbers rounded out to whole numbers.

Practically all Gearmotor manufacturers are cooperating in this new standard speed and recommended practice as adopted by the American Gear Manufacturers Association. It is expected that this new standard speed program will be of considerable benefit to users of Gearmotors, as it will make available a more standardized product, and by reducing the inventory of necessary parts, insure better deliveries.

* * *

Gear Production Continues to Increase

The American Gear Manufacturers Association reports that industrial gear sales for October this year were 20.8 per cent above October a year ago, and 7.4 per cent above September this year. For the ten months ending with October, 1941, gear sales were 86.7 per cent above the corresponding ten months last year. This applies to industrial gears only. The report does not include automotive gears or gears used in high-speed turbine drives.

Ingenious Mechanical Movements

Mechanisms Selected by Experienced Machine Designers as Typical Examples Applicable in the Construction of Automatic Machines and Other Devices

Overload Release Clutch Mechanism

By L. KASPER

In the operation of an automatic machine that produces a formed wire product, it was impossible to prevent occasional jamming when changes in the wire size resulted in imperfect forming. To prevent serious damage to the machine, it was necessary for the operator to cut off the power immediately when the machine became jammed. As the operator was unable to maintain the close watch of the machine required to prevent damage, it was decided to attach an overload release clutch, the design of which will be clear by referring to the accompanying illustration.

The normal operating positions of the overload clutch members are shown in Fig. 1. Driveshaft *A* carries a collar *B*, which is keyed to it. Collar *B* is grooved on the periphery to receive a pad on the long arm of bellcrank lever *D* which swivels on stud *E* carried on gear *C*. Stud *G* on gear *C* carries lever *F*, the lower end of which is provided with a V-shaped cam surface. The lower side of this V-shaped cam is in contact with the rounded end of lever *D*. Spring *H*, attached to the short arm of lever *D* and the lower end of lever *F*, provides sufficient tension to hold the pad on lever *D* in the groove of collar *B* during normal operation. The rotation of collar *B* is thus transmitted to gear *C* through lever *D* and stud *E*, the entire assembly rotating as a unit in the direction of the arrow, as shown in Fig. 1.

In the event that the clutch is overloaded, due to jamming of the work, the resistance to rotation of gear *C* overcomes the tension of spring *H*, causing the pad on lever *D* to be forced out of the groove in collar *B*, and thus disconnecting gear *C* from the source of power transmitted by shaft *A*. The movement of the end of lever *D* on the cam surface of lever *F* swings the latter member to the left; and as the rounded end of lever *D* passes over the high point of the cam surface on lever *F*, the upper edge of the cam surface on lever *F* acts on the lower edge of the end of lever *D*, lifting it completely out of contact with collar *B*, as shown in the diagram Fig. 2, and thus preventing lever *D* from returning to its normal driving position until it has been re-engaged by the operator.

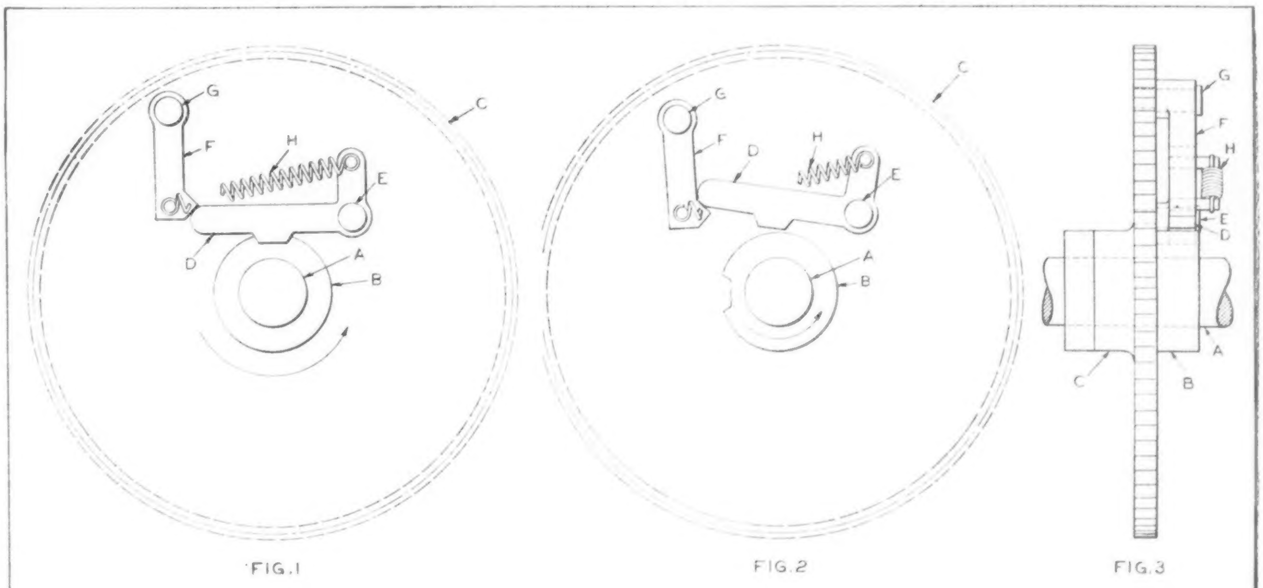


Fig. 1. Overload Release Clutch Mechanism with Driving Members Engaged. Fig. 2. Mechanism of Clutch Shown in Fig. 1 Released by Overload. Fig. 3. End View of Clutch Shown in Figs. 1 and 2

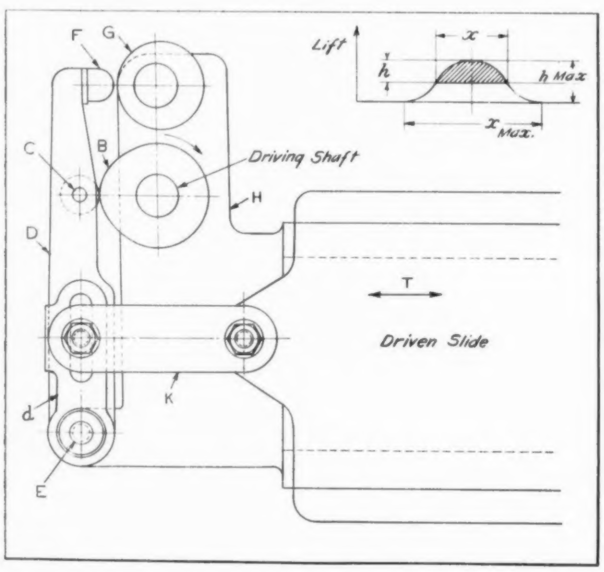
Cam Drive with Variable-Stroke Mechanism

By PAUL GRODZINSKI

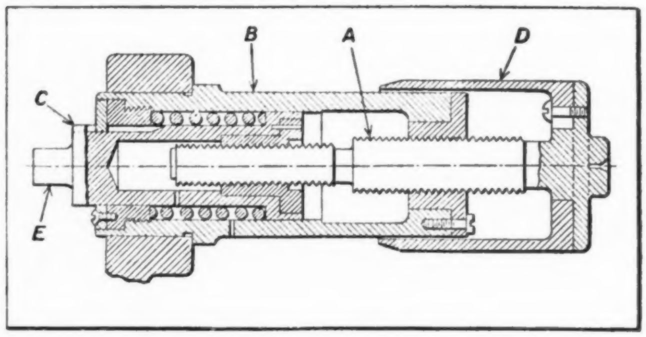
In order to obtain a variable-lift motion from a simple cam mechanism, the length of the follower lever *D* was extended and equipped with a variable stop *G*, as shown in the accompanying illustration. With this arrangement, the stroke of lever *D* is lengthened or shortened as required by adjusting stop *G*. Baseplate *H* carries rotating cam *B*, which is in contact with follower roller *C*, mounted in a slot in locking lever *D*. Lever *D* rocks or swings about pivot *E* and extends beyond follower roller *C*, terminating in a spherical end *F*, preferably made of fiber or laminated plastic material. End *F* is located opposite an adjustable eccentric *G*.

The extension *d* connected to lever *D* is provided with a long slot along which connecting-rod *K* can be adjusted and clamped. Rod *K* connects lever *D* with slide *T*, which represents the driven member. The position of slide *T* during the time in which the reciprocating motion is imparted to it by rod *K* can be changed by adjusting the driving pin in the slot in extension *d*. The length of the stroke can be changed by adjusting eccentric *G*.

This effect is shown diagrammatically in the upper right-hand corner of the illustration. The maximum and minimum lifts of the cam are represented by dimensions *h*, and the maximum and minimum angular movements during which the lift movement occurs are represented by dimensions *x*. By adjusting the stop, the values of these dimensions can be changed from maximum to minimum and, in extreme cases, they can be reduced to zero.



Mechanism for Obtaining a Variable-lift Motion



Cross-sectional View of Differential Screw Mechanism of Micrometer

Differential Screw Micrometer Mechanism

A differential screw mechanism developed by the National Physical Laboratory of England to obtain the magnification of micrometer readings is shown in the accompanying illustration. In this design, two differential screws of relatively coarse pitch are employed to increase the accuracy of the micrometer reading. The larger screw *A* has 20 threads per inch, and the smaller one 25 threads per inch. Both threads are right-hand.

Screw *A* is engaged by a fixed nut at the right-hand end of barrel *B*, while the finer thread screw passes through a nut secured in sliding plunger *C*, the exposed end *E* of which forms one of the measuring anvils. A spring maintains contact between the micrometer screw and the two internal threads. The net movement of the plunger is $1/20 - 1/25 = 0.01$ inch for a complete rotation of the screw. The edge of thimble *D*, attached to the screw, is graduated in 100 divisions, each representing 0.0001 inch, the distance separating adjacent lines being about 0.04 inch.

The magnification with this arrangement is 400, compared with about 60 for an ordinary micrometer having 40 threads per inch and a thimble of about 1/2 inch diameter. A travel of 1 inch of the main screw moves the plunger only 0.2 inch. The total range of the instrument is, therefore, considerably reduced. B. M.

* * *

Safety Code for Grinding, Buffing, and Polishing

The American Standards Association recently approved a Safety Standard for Grinding, Buffing, and Polishing. This standard was originated by the American Foundrymen's Association. Copies of the standard are available from the American Standards Association, 29 W. 39th St., New York City, at 60 cents a copy.

Machine Tools—Old and New—in Defense Production

IN an address on "Modern Machine Tools," presented before the semi-annual meeting of the American Society of Tool Engineers in Toronto, Canada, Fred C. Dull, vice-president of the Monarch Machine Tool Co., Sidney, Ohio, brought out many important points in regard to the use of machine tools in the present emergency. He said that this is no time to argue the question of new machines *versus* old machines; the problem today is one of new machines *and* old machines working together, and each supplementing the other.

People who knew little about machine tools assumed, when increased production of war materials became necessary, that you could take machine tools designed for peacetime production and shift them over to national defense production by the next day. Every man familiar with mechanical production knows that only a part of the machine tool equipment in any one plant can be thus adapted. One large corporation made a survey of from 25,000 to 30,000 machines in use in various plants of the organization. The survey showed that only 40 per cent of the machines could be adapted to war production.

There are, in the main, two reasons for this: First, many of the older machine tools are not capable of the accuracy required; second, a great deal of national defense production has no counterpart in peacetime production. Therefore, there were not available any machine tools that could perform specific jobs. New machines had to be designed for the purpose.

The volume of production demanded by the Defense Program is far beyond the comprehension of anyone who is not actually engaged in industrial work. For example, we have developed in two years an aircraft industry larger than the automobile industry that has grown up during a period of more than thirty years. In a single airplane engine, there are sometimes over 8000 separate pieces of metal, every one of which must be machined.

The machine tool industry was presented with what appeared to be an almost impossible problem when the Defense Program was first considered. However, the industry has met the challenge by a production seven times greater than the average production of the industry over a period of years. By the end of 1941, the machine tool industry will have produced—during 1940 and 1941—300,000 new machine tool units. These new machines are superior to older machines, not only in productive capacity, but also in accuracy.

The Navy Department reports a case where it was found cheaper to turn a certain torpedo part on a new \$3000 lathe than it was to machine it on an old type \$500 lathe, because of the greater productive capacity and accuracy of the new machine. An example where accuracy, as well as speed of production, has greatly aided in the defense effort is quoted from the aircraft industry. Using old equipment, an aircraft engine company rejected from 47 to 49 per cent of the turned bevel-gear blanks coming from a machine. Today, with the installation of new lathes equipped with proper attachments, the machining time has been reduced to one-third of what it was, and the rejections amount to only 2 1/2 to 3 per cent. Such examples could be multiplied indefinitely. A special horizontal drilling machine, for instance, in the plant of an aircraft engine manufacturer performs 35 operations that formerly required eight machines. The work is done in 24 minutes instead of in 4 hours.

Another example is a vertical multiple-spindle drilling machine in an aircraft engine plant which does in 17 minutes what used to require 78 minutes and two machines. In the same plant, a multiple-spindle drilling machine does in 65 minutes what used to take 6 hours and 40 minutes. Valve-seat inserts were formerly ground at the rate of 200 an hour; by the use of a centerless grinding machine designed for that particular job, production has been increased to 1500 parts an hour. A company making airplane propeller shafts has in operation a five-spindle drilling and reaming machine which does in 40 minutes what used to take 3 hours and 22 minutes. These examples indicate what can be accomplished with machines specially built for the job. The armament program lends itself particularly well to the use of special machines, as it generally requires volume production.

* * *

According to Frank W. Curtis, president of the American Society of Tool Engineers, there is more difficulty today in obtaining small tools for defense production than there is in getting machine tools. It is to be expected that there will be continuous expansion in the production capacity of cutting tool manufacturers.

Some Applications of Hydraulic Operation to Machine Tools

A Number of Examples of Hydraulically Operated Equipment, Indicating the Wide Range of Possible Applications
Last of Three Articles

EXAMPLES of hydraulic equipment for the operation of machine tools were described in the August and September numbers of MACHINERY, pages 127 and 141. Additional examples of such equipment will be described in the present and last installment of this series of articles.

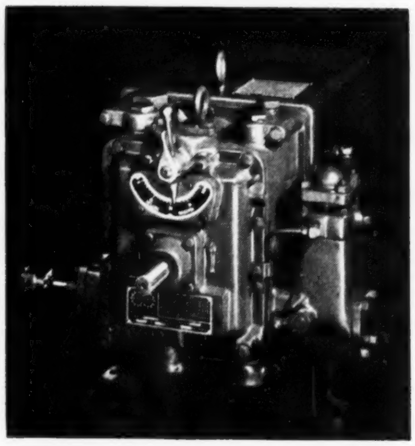


Fig. 8. Oilgear Feed-pump Unit Equipped with Hydraulic Delayed Reverse Attachment

An Oilgear feed-pump unit equipped with a hydraulic delayed reverse attachment is shown in Fig. 8. This attachment is flanged to a pump as an integral part of the unit, and is designed to provide an adjustable delayed reverse at the end of the preset feeding stroke. In Fig. 9 is shown a basic unit equipped with both the fine-feed and the hydraulic delayed reverse attachments. This arrangement illustrates the possibility of combining several attachments in the basic unit. The general installation dimensions and working parts of this unit are shown in Figs. 10 and 11.

When electric control is employed on a machine tool and a delayed reverse is desired, a simple attachment such as shown in Fig. 12 can be used. The desired delay is then obtained through the electric time relay mechanism.

Multi-purpose hydraulic power units built by the Ex-Cell-O Aircraft & Tool Corporation, Detroit, Mich., have been designed to provide an economical method of drilling, reaming, countersinking, or spot-facing. By means of a single tool held directly in the unit spindle or by the addition of a suitable multiple-spindle head attached to the guide flange, any of these operations can be performed in multiple. These hydraulic units can also be used as prime movers or drivers for special machine units designed for milling, boring, or machining operations of a similar nature.

Flexibility is an outstanding feature of these units, which provide a wide range of operating cycles. Rapid approach, two feed rates, jump feed, dwell, rapid return, and stop are all controlled to suit the individual application by dogs that can be adjusted while the hydraulic power unit is in operation. The units can be operated individually or in multiples, and in horizontal, vertical, or angular positions. The feed thrust is applied directly to the quill. It does not vary with the operation, as the hydraulic pressure remains constant in performing each part of the operating cycle. This characteristic prevents the spindle from jumping forward as the cutting tool breaks through the work.

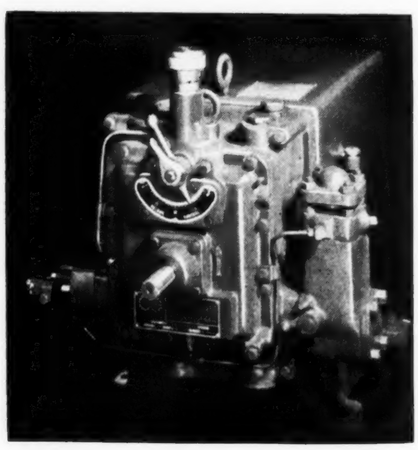


Fig. 9. Basic Oilgear Unit Provided with Both Fine-feed and Hydraulic Delayed Reverse Attachments

The hydraulic control valve assembly, mounted in a recess in the unit, includes all the operating and control valves for the direction of feed, dwell, and rapid traverse functions. This control assembly is removable as a complete unit without dismantling any other part of the power unit. An assembly plate covers the recess in the left side of the unit, and protects the control rods, dogs, two-feed regulating valve adjustments and the oil filler.

Two hydraulic cylinders

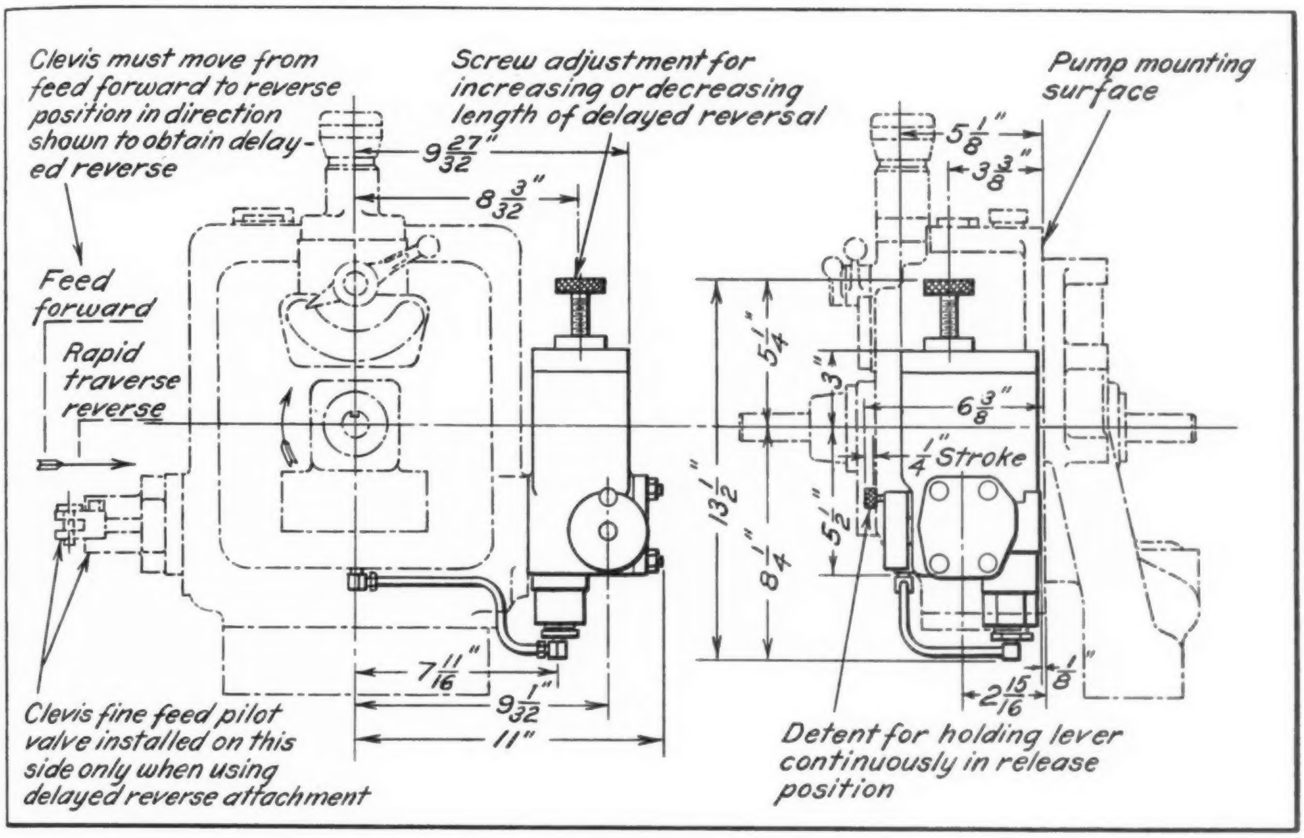


Fig. 10. Diagram Showing Controls and Installation Dimensions of Unit Shown in Fig. 9

Fig. 11. Details of Hydraulic Delayed Reverse Attachment of Unit Shown in Fig. 9

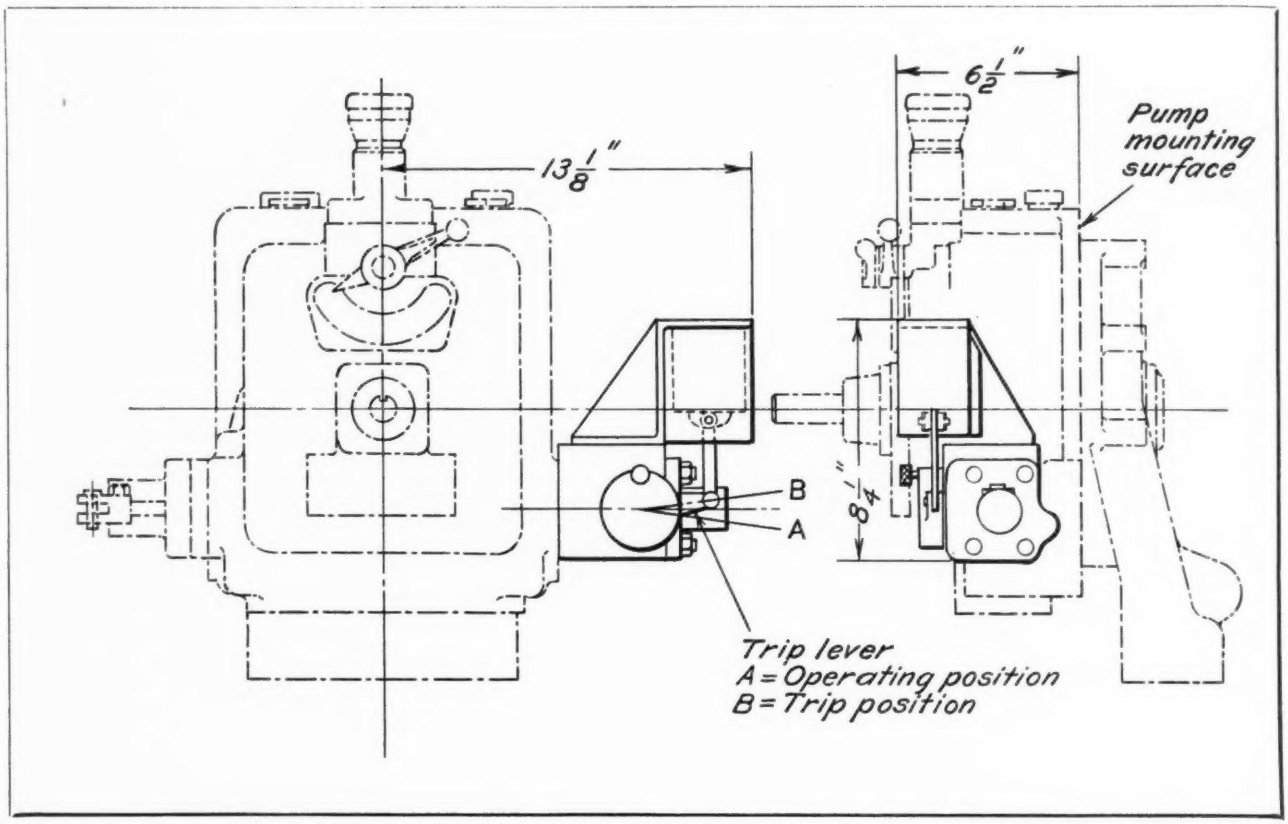
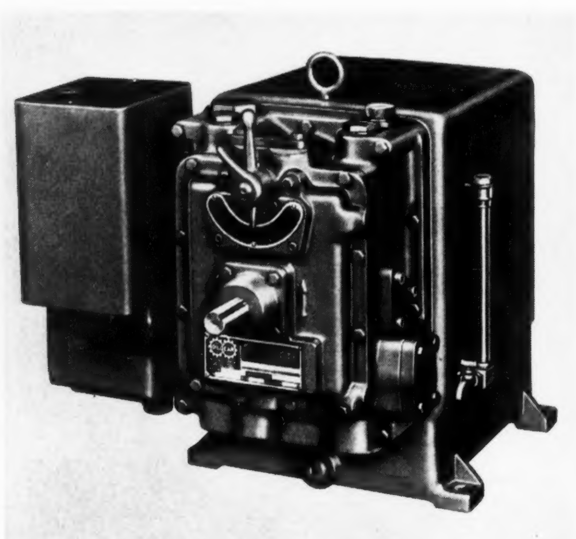


Fig. 12. Oilgear Feed-pump Unit with Electric Delayed Reverse Attachment

are provided in each unit; the large cylinder with its larger capacity is used for operating the feed portion of the cycle, while the smaller cylinder is employed for the rapid traverse of the spindle and quill in either the forward or reverse direction. The electric driving motor mounted on top of the unit drives the hydraulic pump and driving spindle, making the unit entirely self-contained. The motor is belted directly to the hydraulic pump shaft, and drives the spindle by means of a train of pick-off gears at the rear of the unit. By employing this type of drive, the hydraulic pump is permitted to run at a constant speed, while the spindle speed can easily be adjusted by changing the pick-off gears. The units can be operated individu-



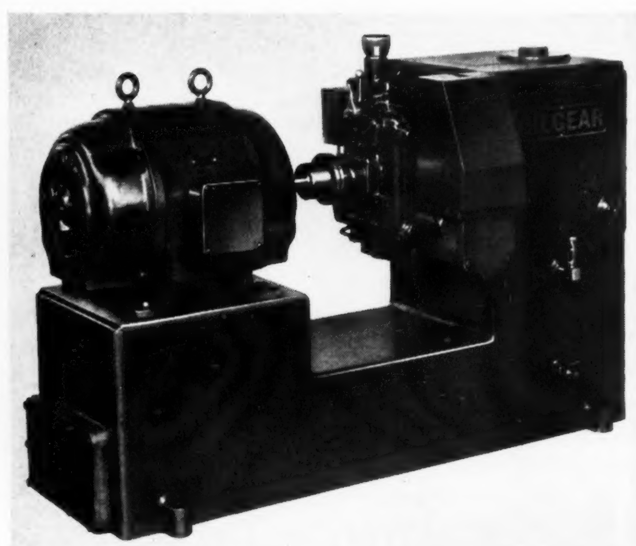


Fig. 13. (Left) Oilgear Feed-pump Unit Equipped with Electric Remote Control. Fig. 14. (Right) Oilgear Feed-pump Unit with Four-position Electric Remote Control, Solenoid-operated Fine-feed Mechanism, Large Reservoir Base, and Direct-connected Motor

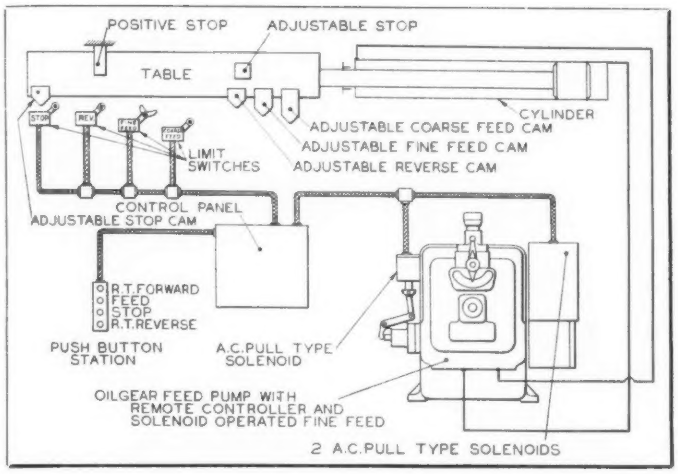


Fig. 15. Diagram of Electric and Hydraulic Equipment Applied to Machine Tool with Two Feeds and Remote Control

ally by either manual or remote control. They can also be operated in multiples, using remote control.

Both simple and somewhat complex mechanical devices previously employed for manual, semi-automatic, or full-automatic control of machine tool cycles are now being replaced by remote control mechanisms and electric push-button control devices. An Oilgear feed-pump unit equipped with electric remote control is shown in Fig. 13. Fig. 14 shows a feed-pump unit equipped with a four-position electric remote control, a solenoid-operated fine-feed mechanism, a large reservoir base, and a drive shaft arranged for direct connection with the motor. Units of this type are being used on a wide variety of steel mill equipment and on various styles of extruding presses.

Figs. 15 and 16 show, in diagrammatic form, the electric and hydraulic equipment applied to machine tools arranged for remote push-button control. Only two pipe lines are necessary to connect the pump and cylinder. A push-button station and small control panel provide for manual operation, while limit switches actuated by simple adjustable cams on the moving table or head provide semi-automatic or full-automatic operation. Energizing or de-energizing the two solenoids on the remote controller, intermittently or in unison through remote push-button stations or limit switches, operates the pilot valves in the pump control and selects the flow of oil required to move the control valve to the desired positions.

A diagram illustrating a semi-automatic cycle, which includes rapid traverse forward, feed forward, rapid traverse reverse, and neutral, is shown in Fig. 16. To start the operating cycle, the "rapid traverse forward" push-button is pressed. Adjustable cam *A* trips limit switch *B*, changing the table motion to a forward feeding movement. Adjustable cam *C* trips limit switch *D*, causing the table to operate at a rapid traverse speed in the reverse direction. Adjustable cam *E* trips limit switch *F*, stopping the cycle. The operator can stop or reverse the table motion at any time by means of the push-button station. For full-automatic operation, limit switch *F* can be made to shift the pump control valve to the rapid traverse forward position.

Fig. 15 shows, in diagrammatic form, the electric and hydraulic equipment applied to a machine tool of similar design, but arranged to provide an adjustable fine feed in addition to the regular functions provided for by the arrangement shown in Fig. 16. Arrangements of this kind that permit the pump to be mounted in a remote position, convenient to the power source and feed cylinder, have done much to make possible modern machine design at reduced engineering and manufacturing costs. Only a small conduit is required to connect the pump with the control station. Thus, the needs of practically every machine tool can be met with commercial feed devices of the types described.

* * *

The amount of awards paid to employes in all the works of the General Electric Co. under the company's suggestion plan for the third quarter of this year was 36 per cent higher than for the corresponding three months of 1940. In total, $23,698 was paid out for adopted suggestions made by employes. In all, 10,852 ideas were turned in during the period mentioned; the number of suggestions adopted was 3098.

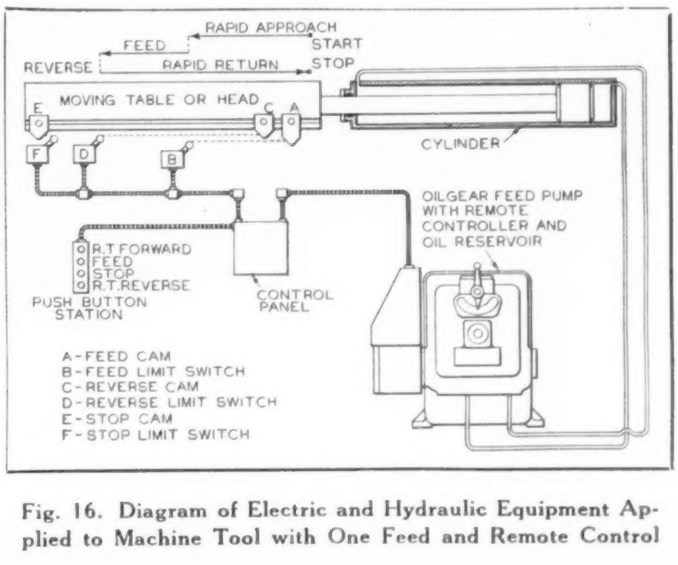


Fig. 16. Diagram of Electric and Hydraulic Equipment Applied to Machine Tool with One Feed and Remote Control

Cyanide Determination in Casehardening Salts

By C. W. STUDER, Chemist
The Hoover Co., North Canton, Ohio

The Scarcity of Cyanide Makes This Method for Determining the Cyanide Content in Salt Baths of Especial Importance at This Time. The Purpose is to Assist Heat-Treating Departments in Maintaining the Right Concentration of the Bath

MOLTEN sodium cyanide has long been used as an effective medium for the introduction of carbon into the surface of low-carbon steels to produce a hard case. Pure cyanide ordinarily is easily obtainable, has a comparatively low melting point, and is readily soluble in water, thus facilitating the cleaning of the work. The pure salt has the disadvantage, however, of volatilizing quite rapidly at temperatures above 1500 degrees F., causing impoverishment of the bath.

Casehardening is no more effectively carried out with pure cyanide than with mixed salts containing 36 per cent cyanide, to which sodium chloride and sodium carbonate are added. Many steel treaters prefer the latter mixture because the cost is lower, the rate of volatilization is decreased, and the "drag-out" loss of cyanide is lessened. Experience has shown that the cyanide content of the mixture should not be less than 30 per cent, and there is no advantage in using more than 38 per cent. When cyanide is scarce, as is now the case, it is increasingly important that mixed salts be used.

It is, therefore, desirable to make periodic determinations of the cyanide content of the bath, but many job shops do not have the necessary facilities for doing this, and consequently, the cyanide content is a matter of guesswork. A method for cyanide determination has been developed at the Hoover Co.'s laboratory which is so simple that the operator can make his own determinations in the shop with inexpensive equipment. The solutions required for a large number of determinations can be made up by any chemical laboratory.

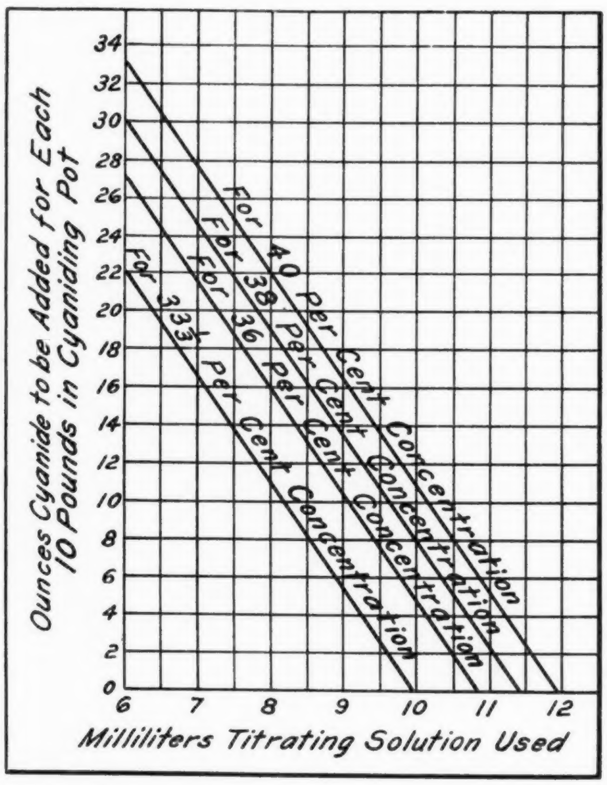


Chart for Use in Connection with the Method Described for the Control of Cyanide Concentration in Casehardening Salt Baths

Theory of the Chemical Reactions

Ammoniacal nickel chloride (a solution of nickel chloride made ammoniacal by adding sufficient ammonium hydroxide to redissolve the precipitate which first forms when added to a water solution of nickel chloride) will react with free cyanide in solution to form a colorless sodium nickel complex. As soon as all the free cyanide has been used, the addition of more ammoniacal nickel chloride will tend to color the solution a bluish-green, indicating that the end point has been reached. As it is rather difficult to observe the end point on this reaction, a modification has been introduced which facilitates the titration.

The titrating solution is prepared by dissolving 30 grams of nickel chloride in 1328 ml. (milliliters) of water, and after solution is complete, adding 1062 milliliters of 28 per cent ammonium hydroxide. The nickel hydroxide precipitate first formed will be

redissolved and a clear blue-green solution obtained. The solution made up as directed will be of such strength that 1 milliliter is equivalent to 0.01 gram of sodium cyanide.

In order to obtain a more noticeable end point, an indicator solution is prepared by dissolving 6 grams of dimethylglyoxime in 1820 milliliters of ammonium hydroxide and diluting the solution with water until a volume of 2 liters is obtained.

A sample of 1 1/2 grams of casehardening salts is dissolved in approximately 200 milliliters of water, and after solution is complete, the volume is increased to 250 milliliters in a volumetric flask. A 20-milliliter portion of the indicator solution is added to a 50-milliliter aliquot removed from the volumetric flask. The ammoniacal nickel solution is added slowly from a burette, and because of the preferential reaction with cyanide, a complex of sodium nickel cyanide is formed. This product is water soluble, and the reaction will continue until all of the cyanide in the solution has been reacted upon.

When this point is reached, the next drop of nickel solution added will react with the dimethylglyoxime to produce an insoluble red precipitate of nickel glyoxime. The appearance of the red color is very obvious, indicating the end point of the titration. The volume of nickel solution used can be determined readily by having taken the original reading and the final reading on the burette.

Since the nickel solution is of such strength that 1 milliliter is equivalent to 0.01 gram of sodium cyanide, one can readily calculate the amount of cyanide present in the 1 1/2-gram sample used originally. It must be remembered that a 50-milliliter aliquot was employed in the titration, and therefore, the difference in burette readings must be multiplied by 5 to make the calculations correct.

Procedure in Sampling

A very satisfactory method of obtaining a sample is to take a small steel mold, and after the bath has been thoroughly stirred, pour the molten liquid into it. The mold can be constructed by taking two pieces of cold-rolled steel, one inch square by about 6 inches long, and clamping them tightly together. Drill a 1/4-inch hole, 3/4 inch deep, so that half the hole is in each steel bar. The sample for analysis is obtained by pouring the molten salts into the mold, using any small ladle. The large mass of metal tends to chill the molten salts very quickly and the pellet obtained will weigh approximately 1 1/2 grams. By using this method of sampling, it is not necessary to employ a chemical balance for controlling the cyanide bath.

In addition to the sampling device described, only a small amount of equipment is necessary for making these analyses. It is convenient to have on hand two 2-liter bottles, several 400-milliliter beakers, one 50-milliliter and one 250-milliliter volumetric flask, one 1000-milliliter graduate, and a 50-milliliter burette.

Calculation of Results

By simple arithmetic one can readily calculate the amount of casehardening salts in the bath, and by knowing the amount of sodium cyanide in the titrated sample, the percentage present in the entire bath can easily be calculated.

Sample Calculation:

$$\frac{\text{Nickel solution (in ml.)} \times 0.01 \times 100}{0.3} = \text{percentage of sodium cyanide}$$

or

$$\text{Nickel solution (in ml.)} \times 3.33 = \text{percentage of sodium cyanide}$$

The illustration is a graphic representation of the number of ounces of sodium cyanide which need to be added to each 10 pounds of heat-treating salts in the pot, according to the number of milliliters of titrating solution used on the sample taken, as stated. Four curves are given to indicate the amount required to bring the concentration up to various points. With a little experience, the operator can estimate closely the amount of sodium cyanide that needs to be added to bring the bath up to the proper strength in cases where the analysis has shown a deficiency.

The method described in the foregoing has proved entirely adequate in production, and the furnace operator soon becomes quite proficient in making the analysis. The cyanide concentration of the casehardening salts is maintained within satisfactory limits and uniform results can be obtained in the hardening operation. Automatic control equipment for maintaining proper temperature and a production schedule that determines the time cycle have been employed for years, and the variation in casehardness obtained on different lots can, therefore, usually be traced to changes in cyanide concentration.

The author is indebted to the Hoover Co. for permission to publish the procedure developed for controlling molten cyanide baths.

* * *

For use in army aircraft, the Brown-Lipe-Chapin Division of the General Motors Corporation is making 0.30-caliber air-cooled machine guns that weigh only twenty pounds. These guns fire 1400 shots a minute.

Heat-Treatment of Molybdenum High-Speed Steels

First of Two Articles Covering Recommendations of a Special Committee of the U. S. Office of Production Management

INCREASING use is being made of molybdenum high-speed steels in place of 18-4-1 and other cutting steels that are difficult if not impossible to obtain without a high priority rating. Many steel users, however, are unfamiliar with the proper heat-treating procedures for molybdenum steels. A special committee of the Office of Production Management has, therefore, prepared certain recommendations intended to prevent difficulties that might arise from using incorrect methods or wrong equipment.

It should be borne in mind that when hardening equipment is available in which decarburization can be controlled, there is no particular problem involved in replacing tungsten high-speed steel with the proper molybdenum high-speed steel. There are differences in hardening temperatures and timing cycles, but the broad general principles are similar.

Table 1 gives compositions for the molybdenum high-speed steels most widely used and established for general commercial tool applications. Other compositions are used for special applications. Since these require special heat-treatment to handle properly, their use is not discussed in this article.

For those who are not skilled in handling molybdenum high-speed steels and who do not have decarburization under good control, it is recommended that the following procedure be adopted for the present:

1. Select the type of molybdenum high-speed steel that will produce the best results and give the least trouble in working. The smaller tools are heat-treated by shorter cycles, and thus the general hazards are less.
2. Proceed on the basis that Type III steels (see Table 1) decarburize less than Type I or II. In most cases, Type III steels can be treated without surface protection in the same equipment as is used for tungsten high-speed steels.
3. Consult with the firms from whom you purchase your high-speed steels for advice on your particular problem.
4. Take steps to obtain modern, efficient hardening equipment on the premise that, regardless of the kind of high-speed steel being hardened, proper hardening promotes better tool life, and better tool life, in itself, is a big step in conservation.

Molybdenum steels can be forged like the tungsten type, but at a slightly lower temperature (see Table 2). When heating molybdenum high-speed steels for forging, they should be held in the furnace for the shortest possible time at the forging temperature. Like all types of high-speed steel, large pieces should be preheated to 1000 to 1200 degrees F. before heating to the forging temperature.

Slightly oxidizing atmospheres are preferred when no protective coating is used. No protection is necessary for ordinary sized forgings unless long heating cycles are involved. Borax is

Table 1. Composition of Molybdenum High-Speed Steels

Element	Molybdenum-Tungsten		Molybdenum-Vanadium	Tungsten-Molybdenum
	Type Ia (Per Cent)	Type Ib* (Per Cent)	Type II (Per Cent)	Type III (Per Cent)
Carbon	0.70–0.85	0.76–0.82	0.70–0.90	0.75–0.90
Tungsten	1.25–2.00	1.60–2.30	....	5.00–6.00
Chromium	3.00–5.00	3.70–4.20	3.00–5.00	3.50–5.00
Vanadium	0.90–1.50	1.05–1.35	1.50–2.25	1.25–1.75
Molybdenum	8.00–9.50	8.00–9.00	7.50–9.50	3.50–5.50
Cobalt	See footnote	4.50–5.50	See footnote	See footnote

*Cobalt may be used in any of these steels in varying amounts up to 9 per cent, and the vanadium content may be as high as 2.25 per cent. When cobalt is used in Type III steel, this steel becomes susceptible to decarburization. As an illustration of the use of cobalt, Type Ib steel is included. This is steel T10 in the U. S. Navy Specification 46S37, dated November 1, 1939.

an effective coating, but has the disadvantage of making the surface of the steel very slippery at the forging temperature; so the operator should take due precautions. To minimize the fluxing action on the furnace refractories, an excess of borax should be avoided.

After forging, it is desirable to cool slowly to about 300 degrees F., in order to avoid cracking from forging strains. This can be accomplished by furnace cooling or burying the work in lime, mica, dry ashes, etc. Tools that have been forged should be machined or rough-ground after annealing to remove surface defects and to reduce the amount of grinding after hardening.

Like tungsten high-speed steels, molybdenum steels should be annealed after forging and before hardening, or when rehardening is required. Box annealing is always preferable. When annealing partially finished tools, and generally when surface protection is of prime importance, it is recommended that cast-iron chips or some other mild source of carbon be used for packing material.

Heat slowly and uniformly to the temperature given in Table 2, soak thoroughly, and then cool slowly in the furnace. The steel should not be taken from the furnace until it is below 1000 degrees F. After machining and before hardening, it may be necessary to relieve machining strains by annealing at 1150 to 1350 degrees F.

Hardening Molybdenum Steels

The general method of hardening molybdenum high-speed steels resembles that used for 18-4-1 steels, but the hardening temperatures (Table 2) are lower and more precautions must be taken to avoid decarburization, especially on tools made from Type I or II steels when the surface is not ground after hardening. Salt baths and atmosphere-controlled furnaces represent an excellent type of equipment for hardening molybdenum high-speed steel. The use of coke fires or the blacksmith forge is not recommended for hardening any high-speed steel, but if this type of equipment is all that is available, Type III steel may be so treated if an excess of air is avoided. However, simple surface protection in such equipment is safer practice, even in the case of tungsten high-speed steels.

The usual method is to preheat uniformly in a separate furnace to 1250 to 1550 degrees F., and then transfer to a high-heat furnace maintained at the hardening temperatures given in Table 2.

When heated in an open fire or in furnaces without atmosphere control, these steels do not sweat like 18-4-1 steels. Consequently, the proper time in the high-heat chamber is a matter of experience. This time approximates that used with 18-4-1 steels, although it may be slightly longer when the lower part of the hardening range is used. Much can be learned by preliminary hardening of test pieces and checking up on the hardness fracture and structure. It is difficult to give the exact heating time, as this is affected by temperature, type of furnace, size and shape, and furnace atmosphere. Rate of heat transfer is most rapid in salt baths, and slowest in controlled-atmosphere furnaces with high carbon-monoxide content.

Quenching and Tempering

Quench the tool in oil, air, or molten bath. To reduce the possibility of breakage and undue distortion of intricately shaped tools, it is advisable to quench in a molten bath at approximately 1100 degrees F. The tool may be quenched in oil and removed while still red, or at approximately 1100 degrees F. The tool is then cooled in air to room temperature, and tempered immediately to avoid cracking.

When straightening is necessary, it should be done after quenching and before cooling to room temperature prior to tempering.

To temper, reheat slowly and uniformly to

Table 2. Heat-Treatment of Molybdenum High-Speed Steels

Heat-Treating Operation	Molybdenum-Tungsten	Molybdenum-Vanadium	Tungsten-Molybdenum
	Types Ia and Ib* (Temp., in Deg. F.)	Type II (Temp., in Deg. F.)	Type III (Temp., in Deg. F.)
Forging	1850–2000	1850–2000	1900–2050
Not below	1600	1600	1600
Annealing	1450–1550	1450–1550	1450–1550
Strain Relief	1150–1350	1150–1350	1150–1350
Preheating	1250–1500	1250–1500	1250–1550
Hardening†	2150–2250*	2150–2250	2175–2275
Salt	2150–2225	2150–2225	2150–2250
Tempering	950–1100	950–1100	950–1100

*Under similar conditions Type Ib steel requires a slightly higher hardening heat than Type Ia.

†The higher side of the hardening range should be used for large sections, and the lower side for small sections.

950 to 1100 degrees F. For general work, 1050 degrees F. is most common. Hold at this temperature at least one hour. Two hours is a safer minimum, and four hours is maximum. The time and temperature depend on the hardness and toughness required. Where tools are subjected to more or less shock, multiple temperings are suggested.

Protective Coatings for Molybdenum Steels

Borax may be applied by sprinkling it lightly over the steel when the latter is heated to a low temperature (1200 to 1400 degrees F.). Small tools heated as described in the foregoing may be rolled in a box of borax. Another method more suitable for finished tools is to apply the borax or boric acid in the form of a supersaturated water solution. In such cases, the tools are immersed in the solution at 180 to 212 degrees F., or it may be applied with a brush or spray. Pieces so treated are heated as usual, taking care in handling to insure good adherence.

Special protective coatings or paints, when properly applied, have been found extremely useful. They do not fuse or run at the temperatures used, and therefore do not affect the furnace hearth. When applying these coatings, it is necessary to have a surface free from scale or grease to insure good adherence. They may be sprayed or brushed on, and usually one thin coat is sufficient. Heavy coats tend to pit the surface of the tool and also are difficult to remove. Tools covered with these coatings should be allowed to dry before they are charged into the preheat furnace. After hardening and tempering, the coating can be easily removed by light blasting with sand or steel shot. When tools are lightly ground, these coatings come off immediately.

Special Suggestions

As in the case of tungsten high-speed steels, tools with sharp corners, variable cross-sections, or of very large sizes should not be given too drastic a quench in oil. It is better to remove the tool from the oil when cooled to or just below a red heat and allow it to cool in the air. Equalizing in lead or molten salt at about 1100 degrees F. and then cooling in still air is good practice.

Single-point cutting tools, in general, should be hardened at the upper end of the temperature range indicated in Table 2. Slight grain coarsening is not objectionable in such tools when they are properly supported in service and not subjected to chattering. However, when these tools are used for intermittent cuts, it is better to use the middle of the temperature range. All other cutting tools, such as drills, countersinks, taps, milling cutters, reamers, broaches, form tools, etc., should be hardened in the middle of the range.

For certain applications requiring a maximum toughness (to resist shocks) the lower end of the hardening range should be used. Such classes of work include slender taps, cold punches, blanking and trimming dies, etc.

Molybdenum high-speed steels can be pack-hardened following the same practice as is used for tungsten high-speed steels, but keeping on the lower side of the hardening range (approximately 1850 degrees F.). Molybdenum high-speed steels will take all the special surface treatments, including nitriding by immersion in molten cyanide, that are used for tungsten high-speed steels for certain applications.

When borax and boric acid are used in a furnace with a silicon-carbide bottom, it is necessary to use a metal pan, preferably of stainless iron, to prevent the borax from fusing with the silicon-carbide. Such fusion produces a glass-like insoluble coating on the tool which is impossible to remove without damage to the edge.

* * *

New Color for Machine Tools

A new and lighter shade of "machine tool gray" than formerly used has been endorsed by the National Machine Tool Builders' Association as the standard finish for machine tools. The date of adoption of the new color is optional, so that each machine tool builder may time the change from the old to the new standard in such a way as to fit his own and his customer's requirements.

The new color is known as "7-B." It was adopted after a careful investigation by the Association's Color Standards Committee. The vote taken showed that most machine tool builders favored a light color, and that the trend among large machine tool users was also for a lighter color. One large machine tool user has repainted all the machine tools in one shop with this lighter color, and has found that because of its good light reflection value, there is one-third better light at working height. The new color will be available from paint manufacturers in quick-drying spraying lacquers and brushing enamels.

* * *

Standards for Reamers

The first American standard for reamers has been approved by the American Standards Association, 29 W. 39th St., New York City. This standard covers dimensions of reamers, number of flutes, and reamer tolerances. It also gives the standard names for reamer parts agreed upon by the Standardization Committee.

Seventy-Seven Machining Operations Performed by Automatic Multiple-Station Equipment

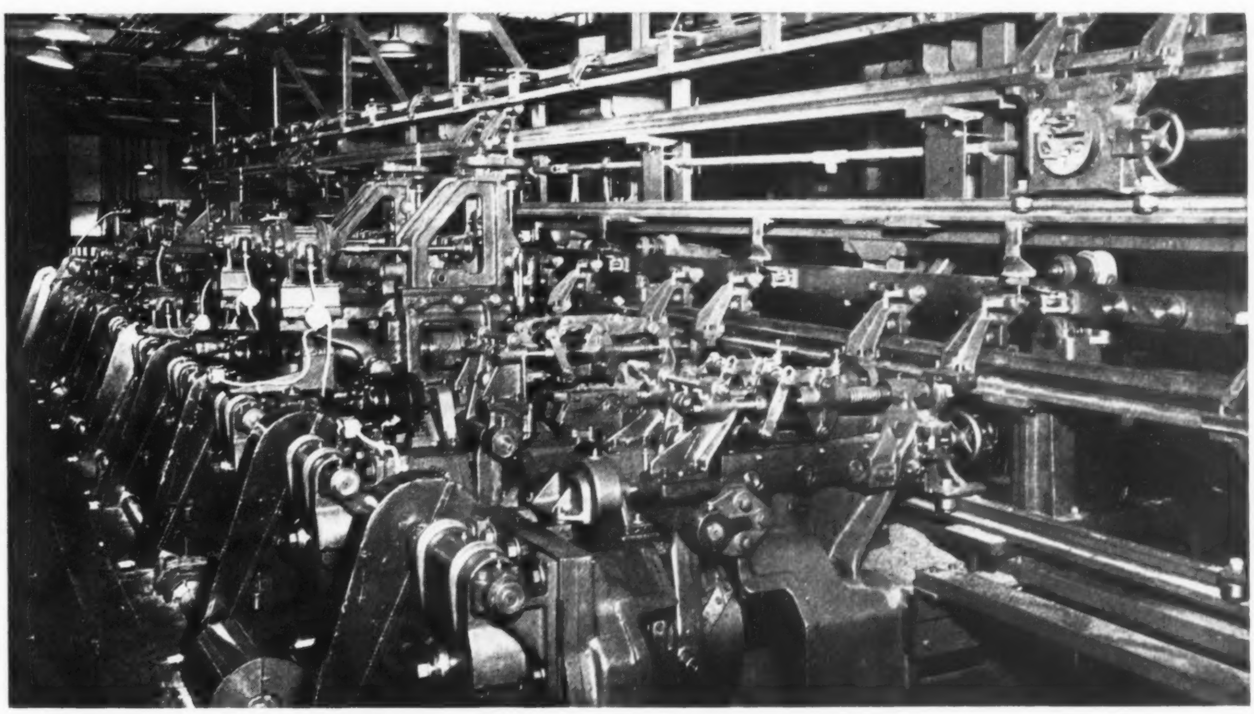
AUTOMATIC "straight-line" multiple-station equipment at the General Electric Co.'s West Lynn Works performs seventy-seven machining operations on cast-iron frames of the company's Type I-30 watt-hour meters at one setting of the work. Drills, counterbores, and taps operate from five directions, and milling is done from two opposite sides. With this equipment, a uniform accuracy is obtained that was not possible by the use of conventional machining methods.

The previous practice was to secure the cast-iron meter frame in a jig and perform all operations possible in a rotary indexing type machine, locating from points on the rough casting. Similar machines were then utilized to complete the operations, and locating was done from the previously machined surfaces. With this method, when the product of the first series of operations was not completely uniform, locating the part by its finished surface in subsequent machines introduced a large number of error combinations which could increase the magnitude of any single inaccuracy three times.

The new equipment consists of eleven machining stations facing a two-level transfer mechanism. This mechanism moves a series of jigs along rails from the loading station into position in front of each machining station. The eleven machining stations are spaced at 4-foot intervals along the 65-foot long transfer mechanism. At the completion of each machining cycle, which takes fifteen seconds, the jigs, traveling along the lower rails, are moved to the next station. When a jig passes the eleventh station, it is transferred to the upper-level rails and returned to the loading end by means of a roller chain. There it is transferred to the lower level again, where an operator removes the finished part and reloads the jig with a rough casting.

Only one operator is required to load and unload the jigs. Another man attends to tool adjustments and replacements, and is responsible to the inspector for the finished work, and for continuity of operation of the machine. The drive of the cutting tools is mechanical, but the transfer operations are hydraulically actuated, as they are intermittent and take place at comparatively high speed. Synchronized movement of the cutting tools and the hydraulic transfers is obtained through the medium of a master control station, which operates limit switches controlling solenoid valves.

Straight-line Machine that Performs Seventy-seven Operations on Meter Bases which Pass on a Conveyor Track before Eleven Stations. A Finished Base is Shown on the Upper Return Track



Advances Made in the Machining of Shells

IN a paper read before the American Society of Mechanical Engineers at Louisville, Ky., on October 15, Malcolm F. Judkins, chief engineer of the Firth-Sterling Steel Co., Firthite Division, McKeesport, Pa., made several interesting comparisons between the methods of shell production in the first World War and those used now. He particularly emphasized how carbide-tipped tools have greatly increased the production possibilities. In this connection, he also mentioned that it is fortunate that tungsten-carbide tipped tools are abundantly available. There is an adequate supply of domestic tungsten ore mined commercially in this country, and there is ample capacity for making sintered-carbide tips.

Shells produced for the first World War, although made in large quantities, were necessarily turned out at slow rates of production and high costs. Cutting speeds with high-speed steel tools used twenty-six years ago were rarely in excess of 45 feet per minute. Coarse feeds of from 1/10 to 1/8 inch per revolution were necessary in order to secure the required production. The machines used were largely engine lathes or single-purpose machines. Existing general-purpose machines were rebuilt and redesigned expressly for machining shells.

The various machining operations necessary to complete the shell from rough forgings were performed successively rather than simultaneously. The use of more than one tool at a time in machining a shell was exceptional. The shell cavity was bored, and this proved to be the slowest of all the operations, becoming, in consequence, the most severe bottleneck. Stress was laid on the bursting characteristics of the shell rather than upon the metallurgy and resulting machinability of the steel used. Despite these very real handicaps, the producers of shells turned out enormous quantities.

The present shell-production methods differ in many respects from those of the last World War. Shells are being produced today in a much greater quantity. The machines now employed are largely automatic. Some of them are expressly designed for shell work. There is a definite trend away from precision automatics, which are sorely needed for other more precise defense work, such as the production of airplane engine parts. The newer shell machines are characterized by simplicity of operation and maintenance, which makes possible the use of semi-skilled and unskilled operators after only brief instruction. The cutting speeds and feeds vary from approximately 300 feet per minute at 0.020 inch feed per revolution for rough-turning to about 400 feet per minute at the same feed for finish-turning.

There has been a corresponding improvement in metallurgy and machinability of shell steel. Today, almost all medium- and small-caliber shells are made from a steel similar to WDX-1335, which is a low-carbon, high-sulphur, high-manganese steel of excellent machinability, coupled with highly satisfactory bursting characteristics. Naturally, there is more uniformity in the shell steel now used.

As a consequence of all these improvements, the cost of producing shells today averages less than 25 per cent of the cost of producing the same caliber shells in the same quantities during the last war. Improved forging practice has played a large part in this cost reduction and in the increased rates of manufacture; and instead of one or, at most, two turning tools working on a shell, as in the last war, today four and even six tools are used. Motors for such modern shell lathes are often of 75 H.P.

* * *

Ohio Crankshaft Co. Marks Anniversary

The twenty-first anniversary of the Ohio Crankshaft Co., Cleveland, Ohio, was celebrated November 18 by an anniversary luncheon and by the first official inspection of the company's new $4,500,000 subsidiary defense plant, that of Ohio Crankshaft, Inc., which is producing crankshafts for the Wright Cyclone engines.

The company started modestly in a 40- by 60-foot garage. It now operates four plants covering 450,000 square feet of floor space, and is said to be the largest independent producer of automotive and heavy-duty crankshafts and camshafts in the country. Its entire output today is for the Defense Program.

* * *

Machinery Exports Show Large Gain

The United States exports of industrial machinery for the month of August, the latest month for which complete statistics are available, totaled close to $42,000,000, an increase of more than 50 per cent over the July figure of $27,800,000. Exports of machine tools amounted to $17,125,000, of which $4,150,000 represented milling machines; $3,545,000, lathes; $1,630,000, drilling machines; and $2,400,000, grinding machines. The exports of metal-working machinery other than machine tools amounted to $3,575,000.

Large Surface Plate with Unusual Rib Design

A new and unusual design of large surface plates to be used in the "as cast" condition has been developed by the Fulton Foundry & Machine Co., Cleveland, Ohio. The original problem was to equalize casting stresses in a plate 96 inches in diameter—a size prohibiting normalizing—and at the same time obtain a permanent trueness after turning and grinding, since no similar hand-scraped plates were available for checking purposes.

It will be noted in the illustration at the right that the spacing of the supporting ribs was proportioned so that they are all of nearly uniform length, and the top was made comparatively thin, as shown in the view at the left, so as to maintain a good proportion between the metal sections of the ribbing and the top. Provision was made for six outside supports and one center support. The plate was cast from Type GA Meehanite, and weighed about 6700 pounds.

In machining, all supports were faced off, and the outer edge was turned. The plate was then inverted and the top finished with only one roughing cut and one finishing cut. Checking of the plate after rough-machining showed that it was true and accurate after the initial removal of the stock; consequently, the plate was promptly given a final finish for size.

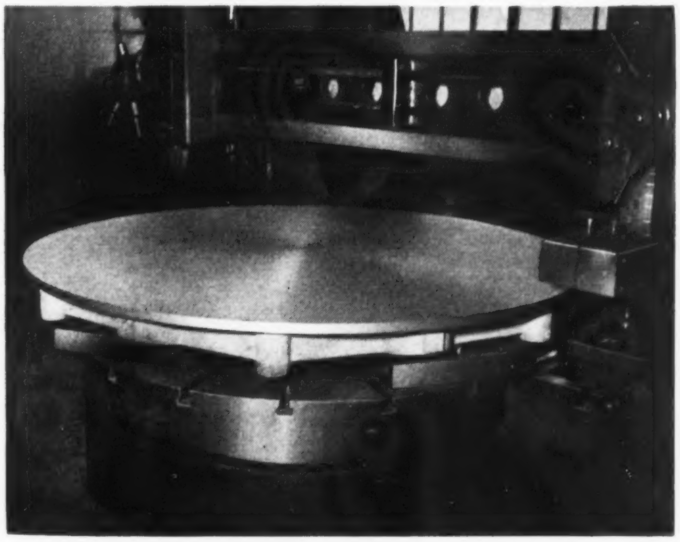
The plate was manufactured for one of the larger anti-friction bearing manufacturers, and is now being used for checking the outer races of the largest roller bearings manufactured by this company. It is supported on concrete piers. This plate has been in service for over a year, and still maintains its original accuracy.

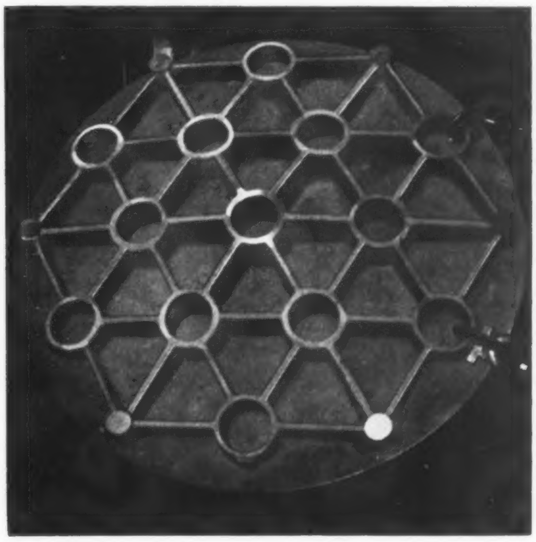
Parts for Assembling Held in Cotton and Cellophane Bags

Parts used in assembling operations are now frequently delivered to the workers in small bags, this being a simple way in which to quickly deliver a complete supply for each unit being assembled. One large manufacturing company uses cotton bags made by the Ames Bag Machine Co., Cleveland, Ohio. Parts for the assembly of electrical industrial trucks and tractors, including lock-washers, nuts, cotter-pins, etc., are placed in a bag or in a small group of bags in the stock-room. A paper tag is sewed into the bottom seam of the bag. This tag is marked for quick identification. As the trucks and tractors move down the assembly line to the point where these parts are needed, the bags are sent to the assembly line. It is said that both time and labor are saved by this method, because, since all the parts are in one place, they are readily accessible.

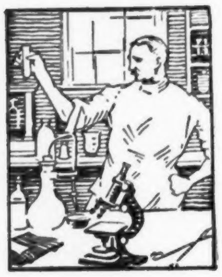
Cellophane bags made by the Dobeckmun Co., Cleveland, Ohio, are also being used for similar applications. These bags are more convenient than small boxes for keeping parts. Furthermore, the boxes take up a great deal more space than the cellophane bags. Another advantage is the ready identification of the contents. White panels are provided on the face of the bags for writing in the necessary identifications, and the cellophane has the additional advantage of permitting the contents of the bag to be seen. The cellophane bags are also moisture-proof, thus preventing the parts from becoming rusted. The top of the bag can be crimped with a set of heated jaws; this makes the bags tamper-proof, as they cannot be opened without the fact being detected.

This Large Surface Plate is of Somewhat Unusual Design, in that the Plate Itself is of Thin Section (Left View), and has a Special Supporting Rib Design (Right View) to Aid in Maintaining Surface Trueness





MATERIALS OF INDUSTRY



THE PROPERTIES AND NEW APPLICATIONS OF MATERIALS USED IN THE MECHANICAL INDUSTRIES

Stainless-Steel Metal Hose Used in Aircraft

Important aircraft producers are using large quantities of flexible stainless-steel tubing for motor accessory parts, according to the *Electromet Review.* The tubing can be obtained either entirely corrugated or with alternate straight and corrugated portions, and can be readily "snaked" into place in such difficult installations as elbows and return bends, thus simplifying many installation problems confronting aircraft designers.

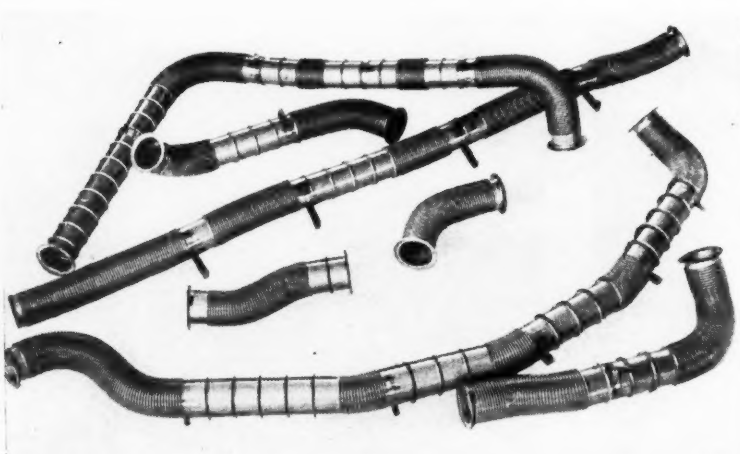
In hot-air ducts and blast tubes for heating parts remote from the motors, advantage is taken of the high flexibility, corrosion resistance, and strength of this type of tubing. It has also proved serviceable in the construction of conduits for high-tension and low-tension wires in electric systems, and for fuel and oil lines where there is need for resistance to vibration fatigue.

As fabricated by the Chicago Metal Hose Corporation, Maywood, Ill., the flexible tubing is made from stainless-steel strip 0.003 to 0.010 inch in thickness. This strip is drawn from coils through a forming device, and is welded into straight tubing having a continuous vacuum type lap of 1/8 inch or less. Fifty-foot lengths of the straight tubing can be readily reduced in a second machine to 15-foot lengths of corrugated or pleated tubing. Any portion of the tubing fed into the latter machine can be left in uncorrugated form where required. Because of the thinness of the tube walls, however, individual circumferential folds are formed in the straight portions at intervals of several inches to provide additional strength.............201

Durex Iron Finds Many Applications

The rapidly increasing use of iron powders in the manufacture of structural, working, and ornamental parts is indicative of their growing importance as industrial materials. One of these powders is Durex iron, a compressed and sintered composition of iron powders and graphite manufactured by the Moraine Products Division of General Motors Corporation, Dayton, Ohio.

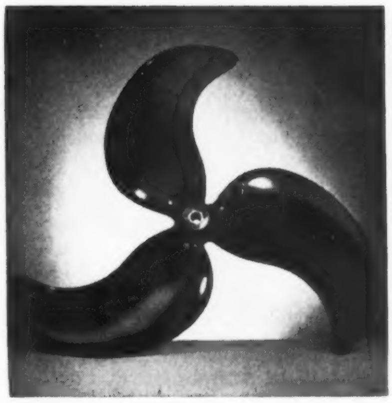
This material has a wide range of physical properties capable of accurate control, and it can be easily formed into complex parts without machining operations. Appreciable production economies are thus made possible. Owing to the graphite content, a certain amount of self-



Various Parts Used in the Construction of Airplane Engines, Made from Stainless-steel Corrugated Tubing to Provide Flexibility, Corrosion Resistance, and Strength

To obtain additional information about materials described on this page, see lower part of page 162

lubrication is also furnished. Durex iron has found successful application in the fabrication of a wide range of parts where porosity, hardness, resistance to wear, and tensile and compressive strengths equivalent to those of cast and malleable irons are required. Thus, it has been utilized for radio tuning brakes, which must meet the requirements of a high degree of hardness, low cost, and close tolerances; oil-pump gears, in which accurately formed tooth profiles, close tooth clearances, and adequate tensile strength are demanded; guide blocks for machine saws, in which the properties of hardness and self-lubrication are important; textile machine bearings, especially in applications where possibilities of corrosion prevent the use of bronze or alloys containing copper; and cams, in which hardness is an important factor and the elimination of special machining and finishing operations is advantageous...202



Fan Blade Molded from Bakelite which Replaces the Former Cast-aluminum Blade

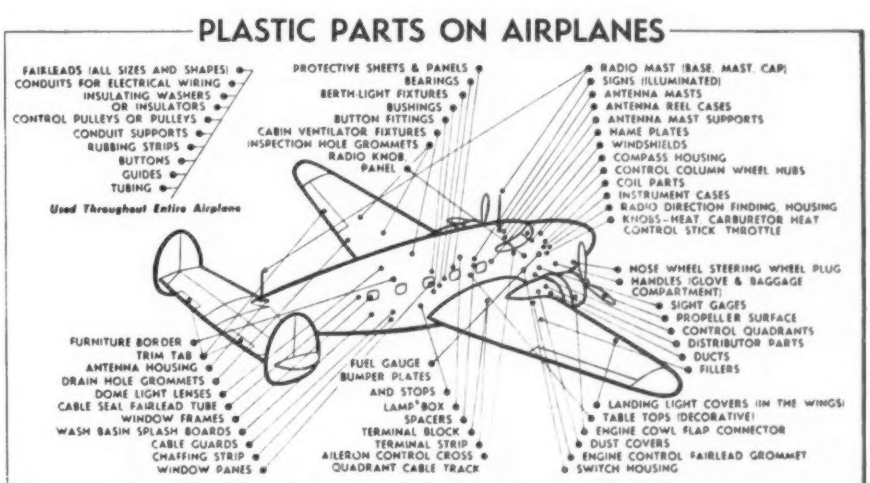
Plastic Replaces Cast Aluminum in Fan Blades

With aluminum rapidly becoming one of the rare metals, as far as civilian industrial usage is concerned, some satisfactory substitute had to be found for the cast-aluminum blades used in the fans manufactured by W. W. Grainger, Inc., Chicago, Ill. Working in cooperation with Grainger engineers, the designers and engineers of the Auburn Button Works, Inc., Auburn, N. Y., developed a molded plastic blade for the purpose. To suit the properties of the Bakelite, which was the plastic material selected, various changes in the design and pitch of the blades were made.

In production and in actual use, these molded plastic blades have not only proved to be efficient substitutes for the cast aluminum originally employed, but they have also evidenced several other desirable characteristics. The light weight of the plastic blades lessens motor strain. Smooth and well balanced, they are quiet at normal speeds and impart little noise to the air stream. Their high-gloss black finish does not lose its luster nor is it easily marred. Furthermore, the low cost of these blades has helped to offset other higher production costs..................203

Black Rustproof Finish for Copper-Plated Parts

A black rustproof finish can be produced on copper by the "Electro-Jetal" process, recently announced by the Alrose Chemical Co., 180 Mill St., Cranston, Providence, R. I. This finish is applicable to any metal that can be copper-plated. After preplating with copper, the parts are immersed in a special electrolytic oxidizing bath for a period of from two to five minutes. The resulting black surface is an excellent absorptive base for subsequent treatment with oil, wax, or lacquer, which gives a non-porous, rustproof finish equivalent to ordinary nickel plate. The Electro-Jetal bath can be operated at any temperature below the boiling point of water, using ordinary steel containers heated by a steam coil. The work can be oxidized on racks, in bulk, or in baskets....................204



Hundreds of Plastic Parts are being Used in Airplanes because of their Strength, Durability, and Light Weight. As Shown in this Diagram, Prepared by E. I. du Pont de Nemours & Co., They Range from Large Windshields Made from Shatter-resistant, Transparent Plastics to Small Buttons, Tubing, Bushings, etc.

To obtain additional information about materials described on this page, see lower part of page 162

NEW TRADE  LITERATURE

Recent Publications on Machine Shop Equipment, Unit Parts and Materials. To Obtain Copies, Fill in on Form at Bottom of Page 161 the Identifying Number at End of Descriptive Paragraph, or Write Directly to Manufacturer, Mentioning Catalogue Described in the December Number of MACHINERY

Munitions Cleaning

MAGNUS CHEMICAL CO., INC., 48 South Ave., Garwood, N. J. Thirty-six page illustrated Munitions Cleaning Handbook, discussing in detail the cleaning problems met with in modern munitions and materiel production. It covers the cleaning of shells, shell cases, small arms ammunition, fuses, ordnance, and transportation equipment. Some of the methods described are also applicable to products outside of the munitions field. 1

Machine Tools—Rebuilt and New

SIMMONS MACHINE TOOL CORPORATION, 1600 N. Broadway, Albany, N. Y. Catalogue entitled "The Simmons Way of Engineering Machine Tool Rebuilding," showing how this company reconditions and modernizes machine tools to meet high standards. The book also illustrates and describes the Simmons Micro-Speed drive and Simmons new lathes, turret lathes, and milling machines. 2

Carbon- and Alloy-Steel Bars (S A E and A I S I Standards)

JOSEPH T. RYERSON & SON, INC., 16th and Rockwell Sts., Chicago, Ill. Pamphlet containing specification comparison of the S A E and A I S I Standard systems of steel identification for carbon- and alloy-steel bars. Complete analyses ranges for carbon and alloy steels of both systems are listed, and the average physical properties are given. 3

Tantalum-Tungsten Carbide Tools and Blanks

VASCOLOY-RAMET CORPORATION, North Chicago, Ill. General catalogue and price list, giving much detailed information on single-point carbide tools, suggestions for ordering tools and blanks, recommended uses for various grades of Vascoloy-Ramet, tables of weights of tools, and illustrations and lists of standard stock tools. 4

Welding and Cutting Apparatus and Supplies

AIR REDUCTION SALES CO., 60 E. 42nd St., New York City. Publication entitled "Air Reduction—A Quarter Century of Progress," containing 54 pages giving a brief history of the organization, growth, and activities of the five companies comprising the Air Reduction Co., Inc. 5

Carbide Tools and Blanks

MCKENNA METALS CO., 147 Lloyd Ave., Latrobe, Pa. Catalogue 42, containing specifications and prices covering the standard Kennametal steel-cutting carbide tools and blanks. Information on the selection and design of tools and blanks, correct grinding procedure, etc., are included. 6

Self-Locking Nuts

ELASTIC STOP NUT CORPORATION, 2310 Vauxhall Road, Union, N. J. Revised general catalogue of elastic stop-nuts and aircraft fittings, containing complete specifications, including prices and application data. Circular L41-23, illustrating various applications of "Elastic Stop" self-locking nuts. 7

Open-Side Planers

CLEVELAND PLANER CO., 3148 Superior Ave., Cleveland, Ohio. Circular descriptive of a new series of Cleveland open-side planers, suitable for use in airplane construction, shipbuilding, and all classes of work that must meet the requirements of high accuracy and speedy production. 8

Grinding Information

NORTON CO., Worcester, Mass. Booklet entitled "What, Why and How—Essential Facts about Grinding," containing comprehensive information on grinding, intended primarily for apprentices, trade and technical school students, and new operators of grinding machines. 9

Lubrication Data

GITS BROS. MFG. CO., 1846-66 S. Kilbourn Ave., Chicago, Ill. General catalogue, containing 172 pages of engineering data on lubrication and information on the selection and use of lubricating devices. Copies available to engineers and purchasing agents. 10

Oil-Cushion Bronze Bearings

AMPLEX DIVISION, CHRYSLER CORPORATION, Detroit, Mich. Catalogue 41 (140 pages) covering Oilite precision, oil-cushion bronze bearings providing strength, durability, quietness, accuracy, ample oil reserve, economy, and a continuous unbroken oil film. 11

Speed Reducers

CLEVELAND WORM & GEAR CO., 3276 E. 80th St., Cleveland, Ohio. Circular 150, entitled "Background," containing quotations from a series of letters from manufacturers in several industries describing their experience with Cleveland worm-gear drives. 12

Tungsten-Carbide Tools

TUNGSTEN CARBIDE TOOL CO., 7171 E. McNichols Road, Detroit, Mich. 4-page bulletin containing specifications and prices for ninety-two different types and sizes of carbide-tipped tools, available for immediate delivery. 13

Welding Data

ARCOS CORPORATION, 401 N. Broad St., Philadelphia, Pa. Tech-

nical bulletin No. 5, containing suggestions on the procedure to follow in welding various types of work with Arcos stainless electrodes, and other information of value to the welder. 14

Hoists and Cranes

CHISHOLM-MOORE HOIST CORPORATION, 122 Fremont Ave., Tonawanda, N. Y. Catalogue 1941, containing descriptive matter and specifications covering Chisholm-Moore hoists, trolleys, and traveling cranes of hand-power and electric types. 15

All-Purpose Milling Machines

PORTMAN MACHINE TOOL CO., 17 Beechwood Ave., Mount Vernon, N. Y. Bulletin describing the features of construction of the Portman "All-Purpose" milling machine, designed to handle practically all classes of milling operations. 16

Individual Motor Drives

MODERN MOTOR DRIVES, INC., 804 McNaughton St., Elkhart, Ind. Folder containing brief descriptions and price list of motor drives, applicable to lathes, shapers, milling machines, punch presses, drill presses, and grinders. 17

Gear-Measuring Blocks

ILLINOIS TOOL WORKS, 2501 N. Keeler Ave., Chicago, Ill. Circular descriptive of Illinois gear-measuring blocks—a simple, accurate means of checking pitch diameter and tooth thickness of spur and helical gears. 18

Machine Tools

SUNDSTRAND MACHINE TOOL CO., 2569 Eleventh St., Rockford, Ill. General catalogue GC-1, covering the Sundstrand line of milling machines, automatic lathes, special machines, and equipment. 19

Nickel-Clad Steel

INTERNATIONAL NICKEL CO., INC., 67 Wall St., New York City. Bulletin T-4, descriptive of methods of fabricating clad-steel plate —plate having protective layers of nickel, Monel, and Inconel. 20

Lighting Equipment

FOSTORIA PRESSED STEEL CORPORATION, Fostoria, Ohio. Circular entitled "Planned Lighting," showing the proper application and style of lighting fixture to obtain the best results in toolmaking, production work, and inspection. 21

Blast-Cleaning Equipment

AMERICAN FOUNDRY EQUIPMENT CO., 555 S. Byrkit St., Mishawaka, Ind. Pamphlet descriptive of the "Wheelabrator," a mechanical unit that utilizes centrifugal force instead of compressed air for abrasive blasting. 22

Ampco Metal

AMPCO METAL, INC., Milwaukee, Wis. Bulletins describing the use of Ampco metal (an aluminum-bronze alloy) in gears and in heavy machinery. Folder on "Ampco Metal in Acid-Resistant Service." 23

Arc-Welding Equipment

LINCOLN ELECTRIC CO., Cleveland, Ohio. Application Sheet No. 77, in a series on Machine Design, continuing a discussion of the design of a press bracket for welded steel construction. 24

Speed Control

REEVES PULLEY CO. OF NEW YORK, INC., 76 Dey St., New York City. Circular briefly describing Reeves variable-speed control units and the speed control service offered by the company. 25

Squaring Shears

NIAGARA MACHINE & TOOL WORKS, 637-697 Northland Ave., Buffalo, N. Y. Bulletin 71-H, illustrating and describing Niagara power squaring shears with capacities up to 14 gage. 26

Sintered-Carbide Cutting Tools

FIRTH-STERLING STEEL CO., McKeesport, Pa. Users' handbook, containing information on how to make, use, and maintain Firthite sintered-carbide cutting tools. 27

To Obtain Copies of New Trade Literature

listed on pages 160-162 (without charge or obligation), fill in below the publications wanted, using the identifying number at the end of each descriptive paragraph; detach and mail to:

MACHINERY, 148 Lafayette St., New York, N. Y.

No.	No.	No.	No.	No.	No.	No.	No.	No.	No.

Name .... *Position or Title* ....

[This service is for those in charge of shop and engineering work in manufacturing plants.]

Firm ....

Business Address ....

City .... *State* ....

[SEE OTHER SIDE]

Control Instruments

BROWN INSTRUMENT CO., Wayne and Roberts Aves., Philadelphia, Pa. Bulletin 85-18, containing technical data on the Brown triple-function proportioning control system utilizing Beck mechanism. 28

Electric Heat-Treating Furnaces

HEVI DUTY ELECTRIC CO., Milwaukee, Wis. Bulletin HD-1041, descriptive of the Hevi Duty pit type convection furnace for operations requiring temperatures up to 1400 degrees F. 29

Die Cradles

ACRO TOOL & DIE WORKS, 2831 Montrose Ave., Chicago, Ill. Catalogue descriptive of the Acro die cradle for supporting dies, jigs, and metal parts in a level position while machining. 30

Metal Shop Equipment

AMERICAN METAL WORKS, INC., 1517 Germantown Ave., Philadelphia, Pa. Leaflet containing illustrated price list covering steel boxes, taper pans, stacking bins, etc. 31

Precision Surface Plates, Angles, Wheels, etc.

MACHINE PRODUCTS CORPORATION, 6769 McNichols Road, Detroit, Mich. Folder on precision surface plates, angles, cubes, wheels, handles, and knobs. 32

Carbon Tool Steel

JESSOP STEEL CO., Washington, Pa. Circular covering heat-treatment and applications of Jessop Lion carbon tool steel, suitable for general purposes. 33

Foundry Ovens

GEHNRICH CORPORATION, Skillman Ave. and 35th St., Long Island City, N. Y. Catalogue 108, on Gehnrich foundry ovens for core-baking, mold-drying, and heat-treating. 34

Heating-Cycle Control Systems

BRISTOL CO., Waterbury, Conn. Bulletin IDS28, describing an automatic heating-cycle control system in operation on furnaces for annealing malleable iron castings. 35

Lubrication Systems

FARVAL CORPORATION, 3293 E. 80th St., Cleveland, Ohio. Bulletin 167, entitled "Why Farval?" describing the Farval centralized system of lubrication. 36

Overload Relief Valves

VICKERS, INC., 1400 Oakman Blvd., Detroit, Mich. Technical bulletin 40-22, on Vickers flow control and overload relief valves for hydraulic volume control. 37

Gear Chucks

GARRISON MACHINE WORKS, INC., Dayton, Ohio. Circular on Garrison gear chucks, showing typical examples of aircraft gears for which they are widely used. 38

Welding Positioners

RANSOME CONCRETE MACHINERY CO., Dunellen, N. J. Bulletin 200, illustrating and describing Ransome welding positioners with capacities ranging from 2500 pounds to 8 tons. 39

Speed Reducers

D. O. JAMES MFG. CO., 1120 W. Monroe St., Chicago, Ill. Catalogue 19, on parallel-shaft, continuous-tooth, herringbone speed reducers; the book also includes engineering data. 40

Rotary Converters

JANETTE MFG. CO., 556-558 W. Monroe St., Chicago, Ill. Bulletin 13-25, illustrating and describing Janette rotary converters and dynamotors. 41

Electric Control Equipment

DONALD P. MOSSMAN, INC., 6021 N. Northwest Highway, Chicago, Ill. Bulletin 61, descriptive of Series 4101 lever switch for electrical control. 42

Protective Coatings

PROTECTIVE COATINGS, INC., 10391 Northlawn, Detroit, Mich. Booklet entitled "The Tocol Line," covering this line of protective coatings. 43

To Obtain Additional Information on Shop Equipment

Which of the new or improved equipment described on pages 163-172 is likely to prove advantageous in your shop? To obtain additional information or catalogues about such equipment, fill in below the identifying number found at the end of each description—or write directly to the manufacturer, mentioning machine as described in December, 1941, MACHINERY.

No.	No.	No.	No.	No.	No.	No.	No.	No.	No.

Fill in your name and address on other side of this blank.

To Obtain Additional Information on Materials of Industry

To obtain additional information about any of the materials described on pages 158-159, fill in below the identifying number found at the end of each description — or write directly to the manufacturer, mentioning name of material as described in December, 1941, MACHINERY.

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Detach and mail to MACHINERY, 148 Lafayette St., New York, N. Y.

[SEE OTHER SIDE]

Shop Equipment News

Machine Tools, Unit Mechanisms, Machine Parts, and Material-Handling Appliances Recently Placed on the Market

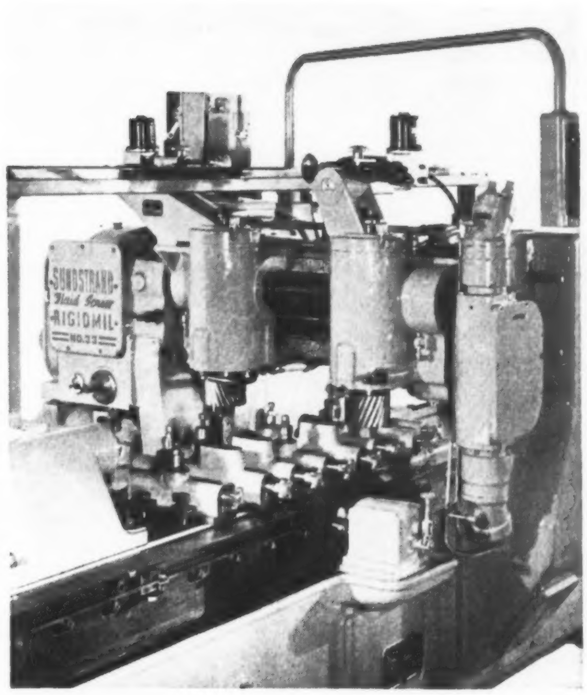


Fig. 1. Close-up View of Sundstrand Propeller-edge Milling Machine Shown in Fig. 2

Sundstrand Propeller-Edge Milling Machine

The Sundstrand Machine Tool Co., 2569 Eleventh St., Rockford, Ill., has recently completed a new machine for milling the edges of propeller blades. This machine, built around the Fluid-Screw Rigidmil, has a number of interesting special features that were developed for the propeller milling operation. In order to permit milling both sides of the blades simultaneously, the machine is provided with two vertical type spindle heads mounted on a cross-rail. Movement of each head along the cross-rail is controlled by a screw driven by a fluid motor which, in turn, is controlled by a hydraulic duplicator attachment.

Attached to the machine table is a two-sided cam on which the duplicator fingers ride. As the table feeds longitudinally, the cam, through the duplicator attachment,

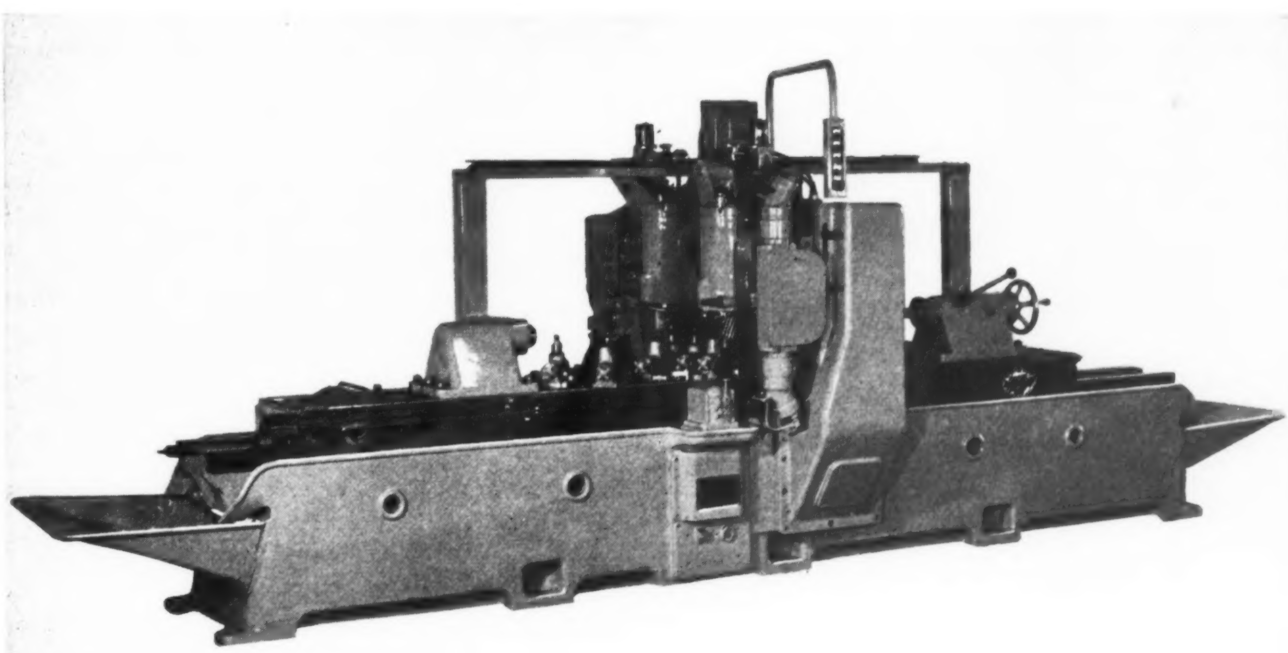


Fig. 2. Propeller-edge Milling Machine Designed and Built by the Sundstrand Machine Tool Co.

To obtain additional information on equipment described on this page, see lower part of page 162

controls the cross movement of the heads, transferring the desired shape to the contour of the part. The heads are both driven from one gear-box and have pick-off gears for simultaneously changing the speed of both spindles.

The part is held on the machine table between a headstock and a footstock member and is supported at intermittent points by jacks. Using spiral milling cutters, the spindles are arranged to rotate so that the cutting thrust is downward against the jacks. This assists in holding the part rigidly in the fixture. After the part is loaded into the fixture, the operator presses the buttons on the electrical control pendent, which starts the spindle and coolant motors. Movement of the control lever on the front of the machine bed then starts an automatic cycle in which the heads traverse rapidly crosswise in opposite directions until the duplicator fingers come in contact with the master templet, after which the cross movement is controlled by the duplicator attachment. At the same time, the table starts to feed the work longitudinally between the cutters.

At the end of the cut, a table control dog serves to reverse the direction of the table feed, and the heads return rapidly to their starting position, where they trip a limit switch which automatically changes the table traverse from reverse feed to rapid return. The table stops automatically at the end of the rapid return stroke. As a safety feature, the cycle is so arranged that the machine table cannot traverse rapidly when the heads are in their cutting positions.

The machine has a traverse movement of 90 inches under power feed. The feeding rate of this movement ranges from 1/2 to 38 inches per minute, with a rapid traverse movement of 300 inches per minute. The feed unit is of the Fluid-Screw Rigidmil type in which the table is actuated by a screw controlled by a hydraulic transmission. This arrangement provides the advantages of a mechanical feed with the flexibility and easy control of the hydraulic feed. 51

Gear-Shaving Machines Designed for Finishing Large Gears

Three new sizes of crossed-axis gear-shaving machines having capacities for finishing gears up to 24, 36, and 48 inches in diameter have been brought out by the Michigan Tool Co., Detroit, Mich. These machines have been developed for finishing large gears, such as are used in speed reducers for ships and large power plants, heavy machinery, machine tools, and ordnance equipment.

A major objective in bringing out these machines was to make possible the production of large gears having accuracy, service life, and quiet-running qualities comparable to those of smaller gears finished by the crossed-axis gear-shaving process. It is claimed that the extreme accuracy of the tooth form obtained when the shaving process is used often makes it possible to reduce the size of the gear without diminishing its power-transmitting capacity. This, in turn, makes possible reductions in the sizes of gear housings.

Four spindle speeds ranging from 109 to 313 R.P.M. are available on the smaller machines, which have twelve feeds of 0.314 inch to 9.485 inches per minute. The largest machine has a feed range of from 0.45 inch to 7.2 inches per minute, obtainable in six steps. The minimum size gear that can be shaved is 1 inch in diameter for the smallest machine; 2 inches in diameter for the intermediate size; and 4 inches in diameter for the largest size. Gears with a face width up to 20 inches can be finished on the largest machine.

For most shaving operations, a work speed of 300 feet per minute is recommended, but the machines are capable of operating with a speed range of from 100 to 400 feet per minute on gears having diameters within their respective capacities. In the smaller machines, the cutter is power-driven and the work follows, being reciprocated axially during the shaving or cutting cycle while the cutters are fed radially into the work. The operation of the speeds and feeds is mechanical.

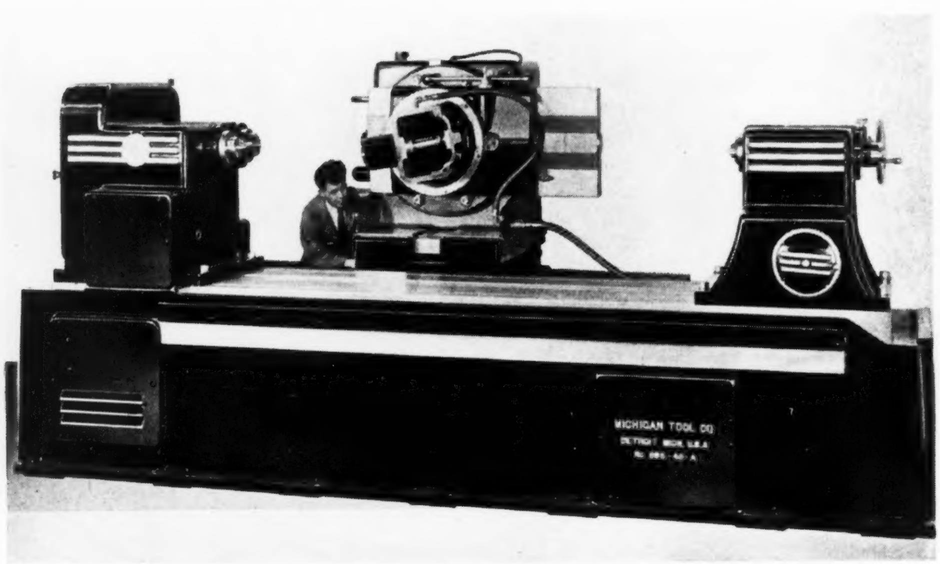


Fig. 1. Gear-finishing Machine of Crossed-axis Shaving Type Brought out by the Michigan Tool Co. to Handle Gears up to 4 Feet in Diameter

In the case of the largest machine, the work is rotated in engagement with the shaving cutter which follows across the face of the gear at a predetermined speed. Two methods of finishing the gear are available on the largest machine. By one method the cutter-slide is reciprocated on an axis parallel with the work axis, and is fed toward the work at each end of the reciprocating movement until a limit stop is reached. The cutter then makes a predetermined number of reciprocations before the cycle is automatically terminated. This

To obtain additional information on equipment described on this page, see lower part of page 162

method is also used with an internal attachment, which only requires that the feed be reversed.

The second method employed with the largest machine requires the cutter-slide to be set in a vertical position, in which case a complete cycle consists of one translation of the cutter and return at right angles to the work axis. The control of the largest machine is entirely electrical throughout its operating cycle. Red, amber, and white signal lights indicate to the operator various circuit conditions existing during the operation of the machine. The 48-inch machine has a bed length of 176 inches, a height of 74 inches over the spindle drive head, a height of 78 inches over the cutter-head, and an over-all width of 119 inches. Work weighing up to 2500 pounds can be supported. In this size machine one motor is used for the main work drive and one for the feed. In the 24- and 36-inch machines both the cutter drive and feed are operated by one motor. 52

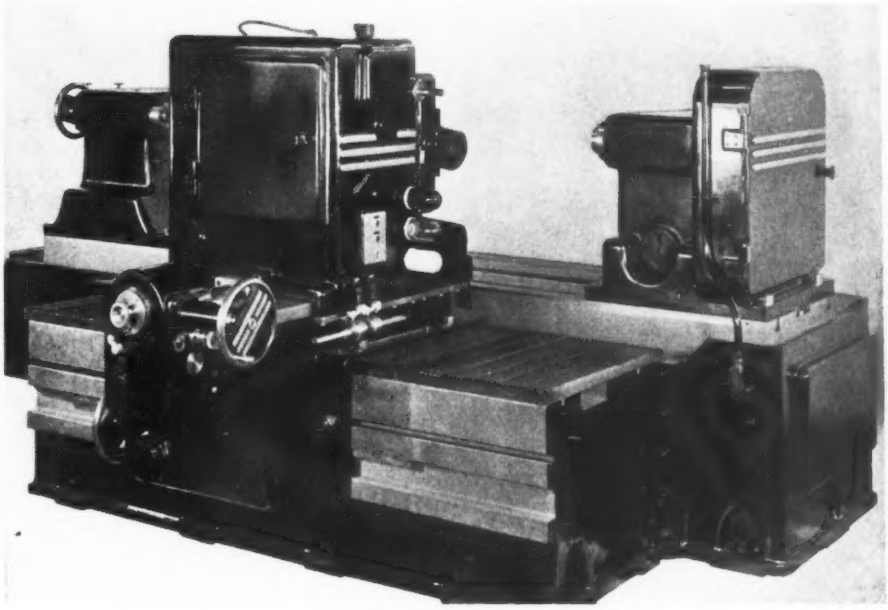
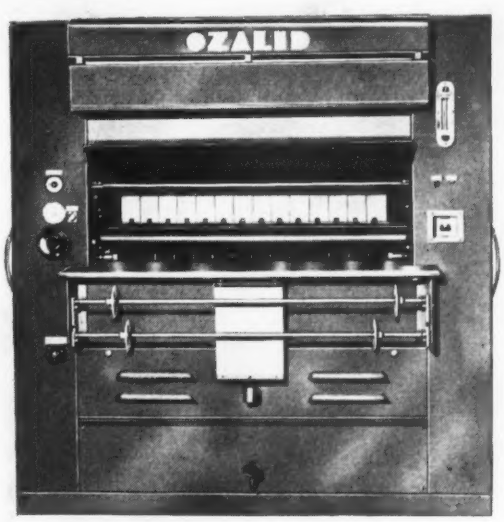


Fig. 2. Control Side of Gear-shaving Machine Shown in Fig. 1

Ozalid Whiteprint Machine

A whiteprint machine designed to produce finished whiteprints at speeds up to 20 feet per minute by the dry developed print method has been brought out by the Ozalid Products Division, General Aniline & Film Corporation, Johnson City, N. Y. The features of this new Model B machine include synchronized printing and developing, which permits the use of continuous roll print material, as well as cut sheets. The temperature control for the printing cylinder permits the entire range of Ozalid sensitized materials to be used efficiently. A special light enables the operator to check prints for correct printing and developing speeds when they are delivered at the rear of the machine.

Other features include front or rear delivery of prints, an adjustable burner shade to permit running prints of varying opacity without changing the printing speeds, an automatic air pick-off, and an effective blower arrangement. The original drawing is placed on a piece of light-sensitized Ozalid material and fed to the machine. First the Ozalid material is exposed to a mercury vapor lamp for printing, and then it is conveyed automatically over a developing tank, where it is dry developed by contact with ammonia fumes. 53



Ozalid Machine Developed for High-speed Production of Whiteprints

General Electric Electronic Motor Control

As an outgrowth of its thyratron speed control for direct-current motors, the General Electric Co., Schenectady, N. Y., has developed an electronic control system designated the "Thymo-trol." This control is designed to provide simple, stepless control of direct-current motors from alternating-current lines where a wide speed range is needed.

With this control, the flexibility of direct-current motors can be combined with the economy and convenience of alternating-current power distribution without the use of motor-generator sets or gear and pulley arrangements. Other advantages claimed for the system include simplified machine design, reduced space requirements, and a saving in time over more complex methods of obtaining a wide speed range.

Normally, this control

To obtain additional information on equipment described on this page, see lower part of page 162

consists of three separate units—a small control station, a transformer, and a thyratron tube panel. This is the first control to provide in one system a means for electronically starting, stopping, accelerating, and regulating the speed of a motor. A thermal overload relay protects the motor, and fuses provide direct-current shop circuit protection. Standard units are made for motor sizes up to 5 H.P. at 230 volts. 54

Jefferson Improved Endless-Belt Sander

Large and flat, as well as concave or convex, surfaces on wood or metal can be given a finish like that obtained by hand-sanding at comparatively great speed on the improved endless-belt sander brought out by the Jefferson Machine Tool Co., Fourth, Cutter, and Sweeney Sts., Cincinnati, Ohio. The flexible sanding belt of this machine is designed to respond quickly to the operator's touch. The table travels on ball-bearing rollers, and can be easily moved back and forth while the operator applies pressure to the flexible belt with a block or pad.

The belt travels at the correct level to enable the operator to work in a natural position without fatigue. The overhead idlers keep the belt up, out of the operator's way. The sanding belts can be easily and quickly changed. The vertical table adjustment of 10 inches permits work of exceptional thickness to be accommodated. The belt standards may be set as far apart as desired to accommodate long surfaces. An auxiliary work-table can be placed on the regular table for handling exceptionally long materials, and the table stand can be readily moved to one side for special work.

The table frame is built of heavy structural steel, electrically welded. The table top is 36 inches wide by 80 inches long, and is built of heavy maple wood. The backward and forward traveling range is 36 inches. The table can be locked in any desired position. An adjustable stop-bar attached to the table is furnished to hold the work in place. A metal rod extending the full length of the table serves as a handle for moving the table back and forth.

The drive is direct from a 2-H.P., ball-bearing, 220- or 440-volt, alternating-current, three-phase, 60-cycle motor, which is fully enclosed. The dust-collector outlet, of cast-iron, with one side hinged, facilitates replacing the endless belt. The belt speed for wood-finishing is approximately 5000 surface feet per minute, and for metal-finishing 1800 surface feet per minute. 55

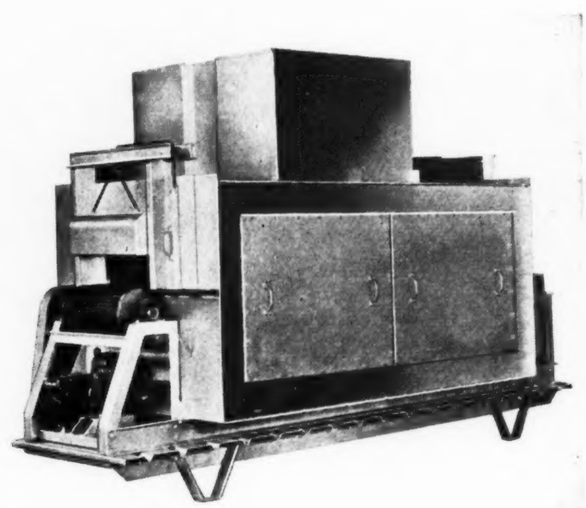
Gehnrich Conveyor Type Heat-Treating Furnace

A conveyor type, convection-heated, low-temperature, heat-treating furnace has been developed by the Gehnrich Corporation, Long Island City, N. Y., for preheating, drawing, normalizing, annealing, stress-relieving, and other heating operations up to 1250 degrees F. on relatively small metal castings, slugs, stampings, and forgings. It is designed to provide continuous relatively fast heat-treatment within close temperature limits.

This type of furnace is applicable to drying or baking bulk chemicals and other processed materials. Preheating and cooling sections can easily be added to the heat-processing chamber when required. The furnace walls are made of patented insulated Dual panels packed with mineral wool blankets. This construction is designed to eliminate through metal joints, with their consequent heat losses, and to provide for ready expansion and contraction of the walls, easy assembly, and enlargement, if the need arises.

The heat source consists of electric heating elements. A fan located above the oven draws the heat from the heaters and discharges it over the full length and width of the oven. This heated air permeates the work, returning to the heater through a fan. The complete recirculating system is designed to effect heat savings and produce greater uniformity in the heat-treating operations. The benefits of convection heating are obtained by drawing the heat from the electric heaters out of the fur-

Improved Endless-belt Sander Brought out by the Jefferson Machine Tool Co.



Conveyor Type Heat-treating Furnace Developed by the Gehnrich Corporation

To obtain additional information on equipment described on this page, see lower part of page 162

nace and then blowing it into the heating chamber so that the work, traveling the full furnace length, is subjected to equal and uniform heating at the desired temperature.

The same furnace can also be arranged for heating by means of a gas- or oil-fired external air heater. The conveyor consists of a wire mesh belt which runs over steel drums and is operated by a motorized variable-speed driving arrangement. 56

Hydraulic Hacksaw

Stepless hydraulic feeds and hydraulic lifting of the saw on the return stroke are features of a hydraulic hacksaw brought out by the L. B. Mfg. Co., P. O. Box 155, Vernon, Los Angeles, Calif. The feed is of the self-compensating, flexible, constant-pressure type. The saw frame is raised hydraulically to the highest point on completing the cut.

The three-speed gear-box is of the integral type. The coolant pump is synchronized with the blade motion. A safety feature prevents the blade from falling on the work. The graduated vise has a jaw that can be swiveled through an angle of 45 degrees. No clutch or countershaft is required, and all working parts are fully enclosed and run in oil. 57

De Walt High-Speed and Heavy-Duty Metal-Cutting Machines

The DeWalt Products Corporation, Lancaster, Pa., has brought out a metal-cutting machine designed for high-speed cutting of round or square bars; tube stock; and brass, bronze, copper, aluminum, duralumin or light steel tubing. Solid bars up to 2 inches in diameter, and 4-inch section material can be cut. A cast-iron base completely covers and protects the working parts, as shown in Fig. 1.

The cutting wheel or saw blade is driven by a two-speed DeWalt electric motor developing 5 H.P. at 3600 R.P.M. or 2 1/2 H.P. at 1800 R.P.M. The motor drives the spindle through five V-belts. The cutter or wheel is fed forward toward the material by a downward motion of the operating handle. The mechanism is so balanced that it will return the cutting wheel automatically after the cut has been completed.

The material is held in the cutting position by two V-blocks that clamp it on both ends. The clamps are operated by a foot-pedal. An adjustable stock stop is provided for continuous cutting operations. This machine requires only 4 square feet of floor space, is 50 inches high, and weighs about 775 pounds.

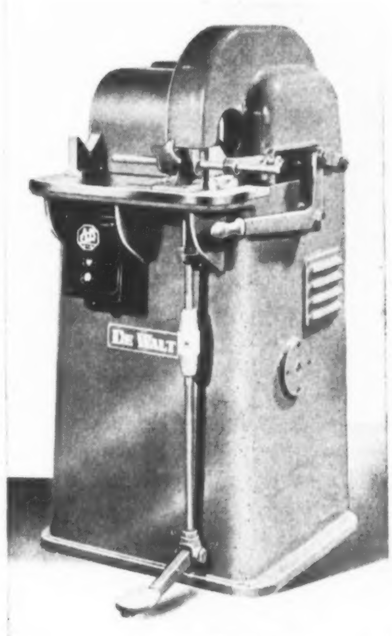


Fig. 1. DeWalt High-speed Metal-cutting Machine

The DeWalt heavy-duty metal-cutting machine shown in Fig. 2 is designed for accurate wet cutting of ferrous and non-ferrous metal, taking both straight and angular cuts. It will cut metals 4 inches thick by 12 inches wide when taking straight cuts, and 4 inches thick by 8 inches wide when taking cuts at an angle of 45 degrees. A 10-H.P. 1800-R.P.M. motor drives the machine.

The cantilever arm carries the

Hydraulic Hacksaw Developed by the L. B. Mfg. Co.

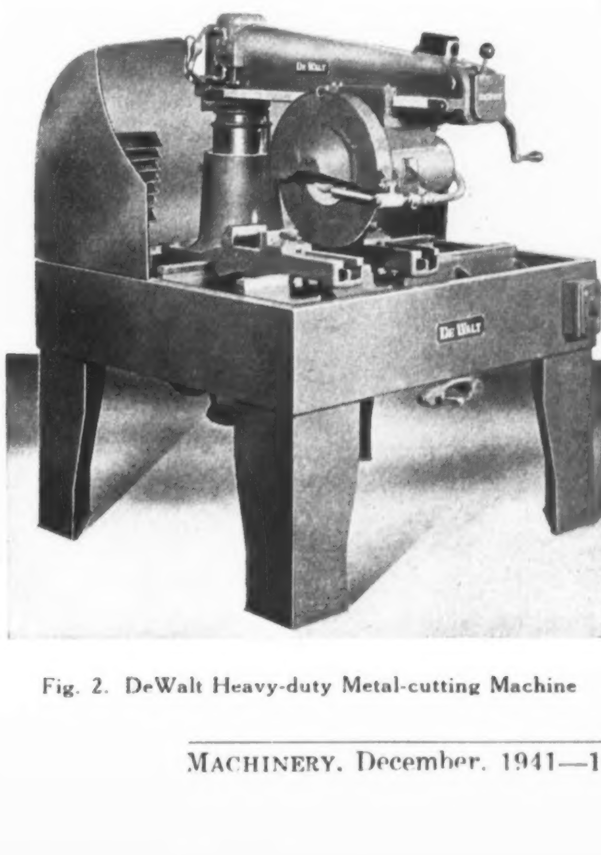


Fig. 2. DeWalt Heavy-duty Metal-cutting Machine

To obtain additional information on equipment described on this page, see lower part of page 162

motor on a bronze slide block that travels back and forth on the arm. A threaded feed-shaft runs through the slide-block within the arm, giving the operator a rigidly controlled feed. Two speeds are provided for rapid return of the cutter. The elevating screw for raising or lowering the column is operated by a crank-handle.

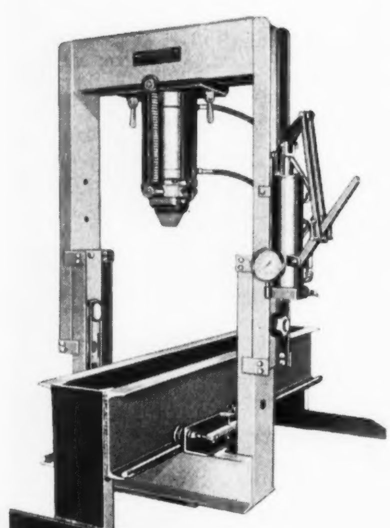
For making angular cuts, the cantilever arm can be swung 45 degrees to the right or left and locked in any position. The vises are air-operated and can be adjusted to handle frail material or to rigidly clamp work requiring severe cuts. A flat cast-iron work-table can be supplied to accommodate jigs and fixtures for special cutting work. Adjustable stock stops provide for continuous cutting. This machine requires a floor space of only 16 square feet, is 60 inches high, and weighs about 2000 pounds. 58

Industrial Hydraulic Press

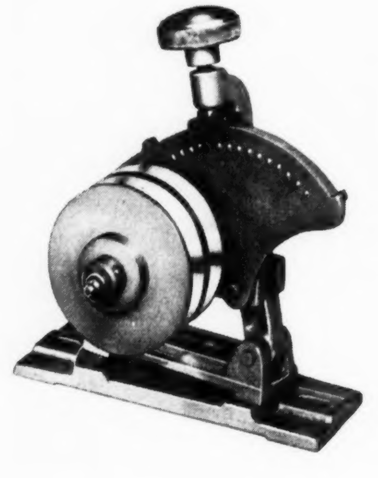
The Bee-Line Co., Davenport, Iowa, has brought out a 125-ton industrial hydraulic press. This press is a powerful hydraulic unit mounted on a movable roller-bearing carriage, which permits the application of pressure at any point in the bed area. The bed measures 84 by 34 inches.

The jack carriage of this press can be raised or lowered 16 inches, and the ram travel is 10 inches. The minimum space between the ram and bed is 2 inches and the maximum space, 28 inches. The jack has a three-speed pressure pump. The complete tool is 8 feet long and 4 feet 8 inches wide.

The press is adapted for use in practically all types of shops, including garages, alignment and spring service stations, foundries, aeronautical and railroad maintenance, and shipbuilding shops. 59



Hydraulic Press Brought out by the Bee-Line Co.

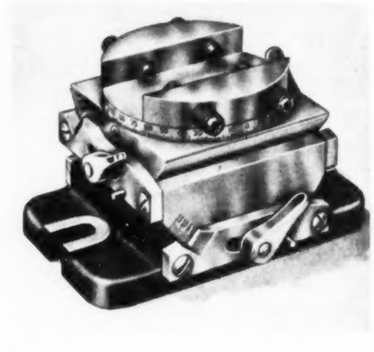


"JFS-CUB" Variable-speed Transmission

Variable-Speed Transmission

A V-belt variable-speed transmission, known as the "JFS-CUB," is being placed on the market by the Standard Transmission Equipment Co., 416 W. 8th St., Los Angeles, Calif. This transmission is especially designed for all A-section V-belt applications and for speed-range ratios up to 3.3 to 1. Smooth-sided pulleys are used rather than the interlocking type.

Among the advantages claimed are the patented positive alignment feature, which makes it possible to mount the transmission in any position without impairing the functioning or throwing the belts out of alignment. The rotating parts are machined and balanced, and are of cast-iron construction. Forced lubrication is provided for the special bronze bearings on which the pulleys rotate. The free-end pulley spindle is designed to permit easy installation of belts. The shipping weight of the transmission is 12 pounds. 60



Hammond Vise for Use in Grinding Chip-breaker Grooves in Tips of Carbide Tools

Hammond "Any-Angle" Tool Vise

The "Any-Angle" tool vise, designed for grinding chip-breaker grooves and tips of carbide tools, and formerly furnished only as part of the Hammond chip-breaker grinder, described in the July number of MACHINERY, page 235, has now been placed on the market as a separate and complete unit by Hammond Machinery Builders, Inc., 1619 Douglas Ave., Kalamazoo, Mich. This vise has a base which can be easily mounted on a machine table. It is constructed on a double-cradle principle, which permits adjustments to grinding angles in three separate planes.

The closely fitted steel blocks can be tightly locked together to eliminate vibration or deflection and insure maximum accuracy in angular settings. The readings on each block are clearly marked. Each tilts 15 degrees either way from the horizontal position, and this adjustment, combined with a 360-degree selectivity of the circular piece at the top, provides for almost any desired angular setting of the vise. 61

"Houghto-Quench" for High-Explosive Shells

On the basis that a rapid quench is highly essential in the heat-treatment of high-explosive shells, E. F. Houghton & Co., Third, American, and Somerset Sts., Philadelphia, Pa., have brought out a quenching oil designated "Houghto-Quench G." This oil is designed specifically to meet the proper range of physical properties, including fire, flash, and viscosity, as well as

To obtain additional information on equipment described on this page, see lower part of page 162

stability, freedom from sludging, and rapid quenching speed.

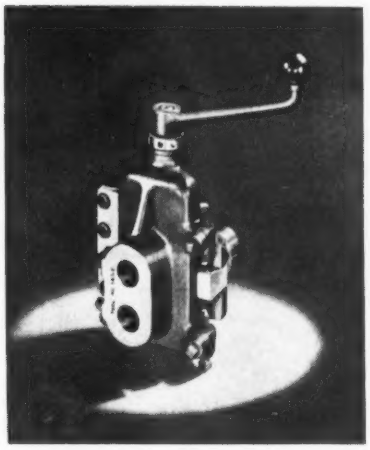
Included in its make-up is a chemical agent which acts as a stabilizer and reduces oxidation or fractional distillation. A synthetic wetting agent is also embodied to provide rapid wetting-out properties, spreading a continuous film of oil speedily over the hot surface of the metal and preventing the formation of gas pockets. 62

"Magni-Ray" Illuminated Magnifier

An illuminated magnifier, designated the "Magni-Ray," which can be connected to any standard 110-volt circuit, has been placed on the market by the George Scherr Co., Inc., 128 Lafayette St., New York City. This magnifier has an unusually wide magnification field and offers scientifically correct lighting directly on the subject, shutting off reflections. It has been developed particularly for use in defense industries, where it is necessary to quickly detect imperfections, such as blow-holes in castings, machine tool beds, tools and dies; cracks in steel after hardening; imperfect welding seams; and burrs and poor finish on small parts, screws, and pins. It is also adapted for use in setting tools on precision lathes, and in setting thread grinding and jeweler's watchmaking machines.

Illuminated Magnifier Placed on the Market by George Scherr Co.

Blueprints, fine dials and graduations, maps, and recording instruments can be read more easily by the use of the Magni-Ray. It is available in two types, one type having a 3-inch lens and the other type having a specially designed 2-inch wide achromatic lens with a magnification power of 3 plus. The three elements in the latter lens are produced from special glass to eliminate distortion. 63



Rapid Slide Tool Brought out by the Gisholt Machine Co.

Gisholt Slide Tool for Turret Lathe

A rapid slide tool for turret lathes has just been placed on the market by the Gisholt Machine Co., 1209 E. Washington Ave., Madison, Wis. This tool is designed to hold small boring-bars and forged cutters. Movement of the lever transmits a rapid, smooth motion to the slide, permitting recessing operations to be performed quickly. Adjustable stops are provided for quick setting, an advantage in duplicate work. 64

"Strikeasy" Arc Welder for Aircraft Work

"Strikeasy" Arc Welder for Aircraft Work Brought out by the General Electric Co.

A 150-ampere, direct-current arc welder designated the "Strikeasy" has been brought out by the General Electric Co., Schenectady, N. Y., for use in welding bright-surfaced, thin-gage metals, such as S A E 4130 aircraft tubing, which has a wall thickness of 35 mils. This welder has been especially developed to produce strong, uniform joints quickly and without spoilage. An outstanding feature is the high instantaneous recovery of voltage—40 to 60 volts—which facilitates striking the arc under the difficulties presented by thin metals having a bright polished surface.

Rapid, accurate adjustment of the welding current is provided by a tap switch and rheostat. The wide welding range permits the use of shielded-arc electrodes as large as 3/16 inch in diameter and as small as 3/64 inch in diameter. The welder can be used with a remote control device for reducing the current when it is desired to fill a weld crater or when a reduction of heat is needed to avoid burning through the metal.

Cool operation is obtained by means of a fan-cooling system, while isothermic relays guard against operation on harmful overloads. The welder is available with or without running gear. Without running gear, the over-all dimensions are: Length, 28 inches; width, 13 1/2 inches; height, 21 inches; and weight, 385 pounds. With running gear, the over-all dimensions are: Length, 40 inches; width, 16 inches; height, 27 inches; and weight, 415 pounds. 65

Rectifier for Operating Electromagnetic Chucks

The Savage Tool Co., Savage, Minn., has brought out a simple, compact, DoAll rectifier for use where alternating current must be transformed into direct current for the operation of electromagnetic chucks. The rectifier is enclosed in a self-contained steel case, 11 by 4 3/4 by 7 3/4 inches in size. A

To obtain additional information on equipment described on this page, see lower part of page 162

built-in pilot light shows when it is in operation, and fuses prevent damage to either the rectifier or magnetic chuck. It is built specifically for operating the electromagnetic chucks supplied with DoAll grinders, but will operate any electromagnetic chuck from 6 by 18 up to 8 by 24 inches in size. 66

Reciprocating Electric Sander

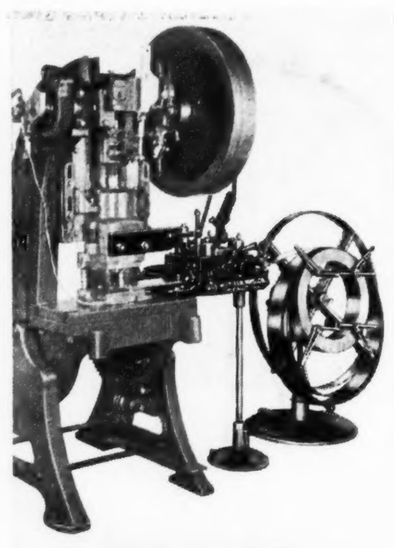
The Detroit Surfacing Machine Co., 7433 W. Davison, Detroit, Mich., has brought out a new model "Easy-XL" sander, designed to withstand the severe usage encountered under continuous service resulting from two- and three-shift operation in defense industries. This sander embodies numerous improvements, including reduction of vibration to a minimum through precision balancing and redesigning of the handle mountings. An interchangeable front handle, which can be shifted to the side position, enables the operator to work in close corners at right angles and directly against vertical surfaces.

An improved type fan and baffle plate increase the flow of air through the motor, thus insuring adequate cooling. The motor filter and switch are readily accessible through the new type motor filter cap. These sanders are available with 110- or 220-volt motors for various finishing applications, including sanding, rubbing, and polishing metal, plastics, wood, leather, or composition materials. 67

Electric Sander Made by Detroit Surfacing Machine Co.

Wittek Automatic Roll Feed and Reel Stand for Punch Press

The Wittek Mfg. Co., 4305 W. 24th Place, Chicago, Ill., has brought out a Model 6L automatic roll feed and a Model 3B reel stand designed for rapid, smooth, and accurate feeding of strip stock to a punch press. The rolls of the feed turn constantly while the forward movement of the stock is arrested momentarily by releasing the rolls during the stamping operation and ejecting of the stamped part.



Punch Press Equipped with Wittek Automatic Roll Feed and Reel Stand

Power for driving the feed is transmitted by chain from a sprocket mounted on the crankshaft of the press to a sprocket on the drive shaft of the feed. An adjustable chain tightener takes up the slack and permits the use of interchangeable sprockets to obtain any desired speed ratio between the press and the feed. 68

Truing-Diamond Holder

The Diamond Tool Co., 938 E. 41st St., Chicago, Ill., is incorporating a new feature, known as the "Loc-Key-Set," in all the diamond nibs of its "Big-Hed" line. This feature consists of two internal locking keys that are cast integral with the slug-holding nib by forcing molten metal into two internal

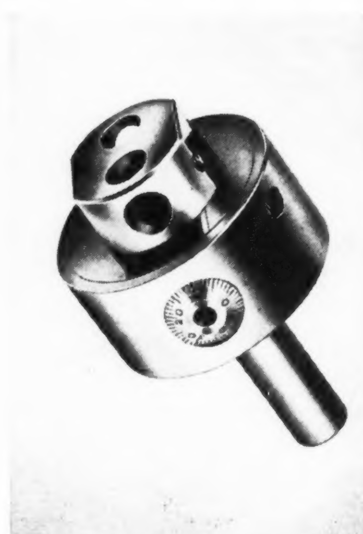
Truing-diamond Holder Made by the Diamond Tool Co.

keyseats in the nib head, as shown by the phantom view in the accompanying illustration.

It is claimed that diamonds set in this manner never shift, turn, or loosen in operation, making possible micrometer adjustments of the truing diamond for each pass across the wheel. It is also stated that the large-diameter head draws heat away from the grinding point and dissipates it rapidly, thus providing cooler dressing and preventing tool expansion, as required for close-tolerance work. 69

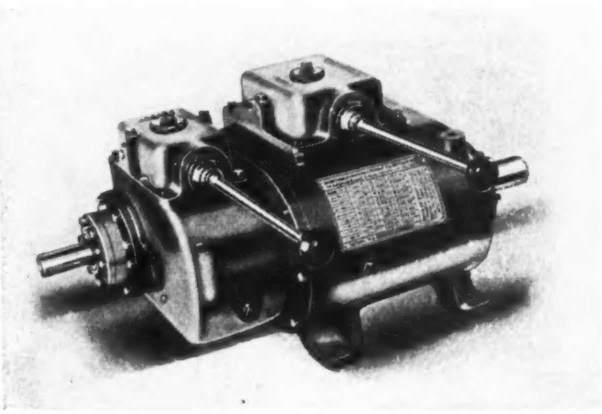
"Junior" Offset Boring Head

A "Junior" model offset boring head for tool-room work has recently been added to the standard line of offset heads made by the Fray Machine Tool Co., Glendale.

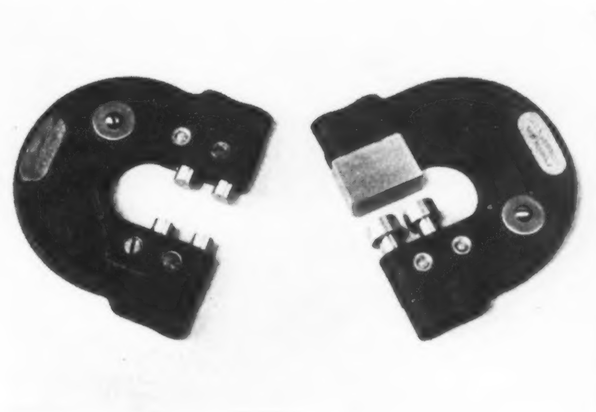


Offset Boring Head Added to Line Made by Fray Machine Tool Co.

To obtain additional information on equipment described on this page, see lower part of page 162



Western "Super" Model Transmission



Atlantic Adjustable Limit Snap Gages

Calif. A special feature of this head is the retaining ring over the complete assembly, which assists in carrying the load on the tool-carrying block and helps exclude chips from the micrometer mechanism. The use of this retaining ring makes possible the round type of construction without introducing unsafe or hazardous features.

The Junior model has a 2-inch body diameter with an over-all head length of 1 5/8 inches and an offset of 5/16 inch. The micrometer dial has fifty divisions of 0.001 inch each. The shank is 1/2 inch in diameter, straight, and has three 3/8-inch receptacles for boring-bars. 70

Western Transmissions for Machine Tools

A new transmission, designed for motorizing cone-driven machine tools, is being placed on the market by the Western Mfg. Co., 3428 Scotten Ave., Detroit, Mich. This transmission can be used to replace gear-boxes on large boring mills, radial drills, etc., and can be used to motorize large slotters, as well as engine and turret lathes. Eight changes of speed in geometric progression of 1.29, with a maximum reduction of 6 to 1, are available.

The line consists of three models, covering a capacity range for motorizing machine tool equipment from 1 to 30 H.P. The "Master" model has a capacity of 1 to 5 H.P.; the "Major," a capacity of from 5 to 10 H.P.; and the "Super," a capacity of 10 to 30 H.P.

Three types of mounting brackets are available—a lathe bracket adapted for motorizing automatics, bolt cutters, Fellows gear shapers, vertical milling machines, radial drills, turret drills, screw machines, etc.; a shaper bracket which can also be used for boring mills, vertical mills, etc.; and a milling machine bracket. 71

Atlantic Adjustable Limit Snap Gages

The George Scherr Co., Inc., 128 Lafayette St., New York City, is now manufacturing a line of adjustable limit snap gages designated "Atlantic." These gages conform with the American gage design standards and have frames made of Meehanite castings which have high tensile strength and retain their original form.

The gages are manufactured in two standard types — Model A, which has four gaging buttons, and Model C, which has a solid block and two gaging anvils. The line includes gages of thirty sizes. ... 72

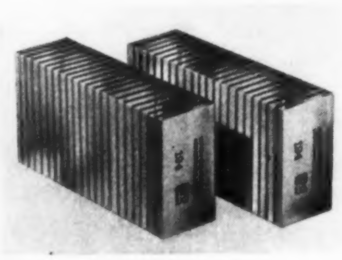
Coolant Pump Made by the Eastern Engineering Co.

Eastern Coolant Pumps

A new series of coolant pumps known as Model No. 17 is being added to the line of the Eastern Engineering Co., 45 Fox St., New Haven, Conn. These pumps require no priming, and are of the open impeller type. Small chips or grit can pass through the pumps without harming them. The compact design enables the pumps to be installed in small spaces. They are intended for use on lathes, shapers, and milling, drilling, and grinding machines, where a steady stream of coolant or cutting oil is necessary. They are also suitable for use in circulating non-viscous liquids for cooling applications.

The pumps are available in two heights—the larger being 19 3/4 inches high, and the smaller 16 3/4 inches high. The weights are 35 and 30 pounds, respectively. A 1/8-H.P., 1725-R.P.M., ball-bearing, impulsion-induction, semi-enclosed motor for operation on 110- or 220-volt, 60-cycle, single-phase current is employed. The inlet is tapped for 1 1/4-inch standard pipe, and the outlet for 1/2-inch standard pipe. The pumps have a maximum capacity of 17 gallons per minute at a pressure of 6 pounds per square inch. They can be furnished with flanged, bracket, or sump type mountings. 73

To obtain additional information on equipment described on this page, see lower part of page 162



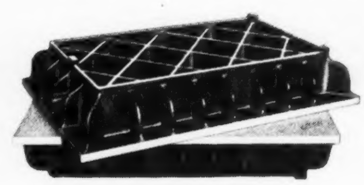
Brown & Sharpe Parallels for Magnetic Chuck

Brown & Sharpe Magnetic-Chuck Parallels

The Brown & Sharpe Mfg. Co., Providence, R. I., has recently brought out magnetic-chuck parallels for holding small work that cannot be held directly on the working surface of a magnetic chuck. These No. 124 parallels can be used on chucks of the permanent-magnet type and also on chucks of the non-magnetic type. They are made of alternate steel and non-magnetic bronze spacing strips. The magnetic flux from the chuck is conducted through the steel strips and work, holding the work securely to the parallels and the parallels to the working surface of the magnetic chuck. They are 3 15/16 inches long, 7/8 inch wide, and 1 7/8 inches high, and are made in matched pairs. 74

Reid Master Surface Plates

The Tool Engineering Service Co., Inc., 243 Washington Ave., Nutley, N. J., has brought out a line of Reid master surface plates designed for use in laying out, inspecting, assembling, and checking work requiring extreme accuracy. The line includes eight sizes, the smallest being 12 inches wide, 18 inches long, and 3 inches high, and the largest 48 inches wide, 72 inches long, and 12 inches high.



Master Surface Plates Made by Tool Engineering Service Co.

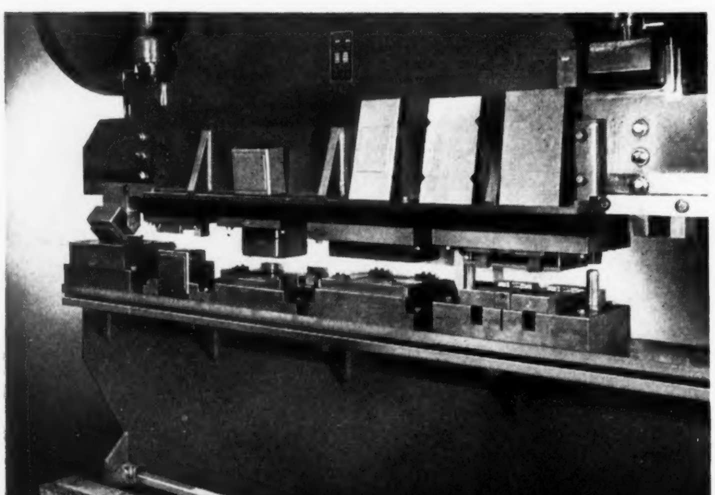
These master plates are normalized and weather-seasoned. They are available with either a scraped or a planed finish. The heavily webbed underframes of these plates are designed for three-point support. All planing and precision scraping operations are performed with the plates resting on their three supporting points. All scraped plates are provided with covers. The large plates have a tapped hole for a standard eye-bolt at each end to facilitate handling. 75

Progressive Forming Operations on Bending Press

As has been demonstrated many times, the necessity of turning to new methods of manufacture because of restrictions imposed by war requirements often results in considerable economies. This proved to be the case when, because of defense priorities, one manufacturer could not obtain zinc die-castings for boxes and was forced to turn to the use of sheet steel. The stock available was not drawing steel and had a rather wide commercial variation in gage thickness.

Because of these two factors it was decided to utilize a bending press. A Sturdybender press, manufactured by Cyril Bath & Co., Cleveland, Ohio, was used to form the boxes in five successive operations. The first operation consisted of blanking and piercing the piece; the second, of embossing the forward face of the box and turning up the flanges; the three successive steps completed the piece, including the formation of projections for welding on the side walls of the box. Safety devices were later fitted to the press. The production was 35 to 40 boxes an hour, only one operator being required.

Several advantages were found to result from this arrangement. Special drawing steel was not required. The box was completed without being removed from the machine or conveyed to another press, resulting in a marked saving in handling time. The floor space requirements were much less than if a number of separate tools had been employed. Savings were also effected in electric power and in the cost of dies, the type of dies used being less expensive than drawing dies.



Cyril Bath Sturdybender Press Set up to Perform Five Successive Forming Operations on Sheet-metal Boxes. The Manufacturer Selected Sheet Steel to Replace Zinc Die-castings, which were Unavailable because of Defense Priorities

To obtain additional information on equipment described on this page, see lower part of page 162

NEWS OF THE INDUSTRY

Illinois

FAIRBANKS, MORSE & Co., 600 S. Michigan Ave., Chicago, Ill., announces that the government has authorized the company to expand $5,500,000 for a new 660- by 460-foot building and additional equipment at the Beloit, Wis., works of the company. The purpose of the new plant is to triple the production of Fairbanks-Morse Diesel engines for the United States Navy. It is expected that the plant will be completed and in operation in about a year. Between 1200 and 1500 employes will be added to the factory force.

A. E. AVEYARD, former executive vice-president and director in two of the largest advertising agencies in the United States, has joined Hays MacFarland & Co., 333 N. Michigan Ave., Chicago, Ill., as partner and vice-president. The name of the agency will be changed to MACFARLAND, AVEYARD & Co.

LORD MFG. Co., Erie, Pa., announces the appointment of GEORGE P. HERRINGTON as sales and engineering representative for the mid-western states. Mr. Herrington will represent Lord bonded rubber products in the mid-western states, with headquarters at 844 N. Rush St., Chicago, Ill.

Michigan

MARVIN W. DAVIS has been appointed sales manager of the Suprex Gage Co., Pleasant Ridge, Detroit, Mich. Mr. Davis was at one time supervisor of inspection in the Methods and Standards Department of the Studebaker Corporation. After leaving the Studebaker Corporation, he became associated with the Taft-Peirce Mfg. Co. as district sales manager in the Detroit territory, and later joined the Sheffield Gage Co. as sales manager.

GIERN & ANHOLTT TOOL Co., INC., 1312 Mount Elliott Ave., Detroit, Mich., is building a 30- by 200-foot addition to its plant. The new building is to be used as an erection shop for heavy-duty carbide boring machines built by the company for work connected with the Defense Program.

CLIFF BENDLE, sales engineer with Crobalt Inc. since its establishment in 1932, has been appointed sales manager. His headquarters will be at the new Crobalt plant in Ann Arbor, Mich.

Robert J. Howison, Appointed Sales Manager of Automotive Division, Morse Chain Co.

ROBERT J. HOWISON has been appointed sales manager of the Automotive Division of the Morse Chain Co., Detroit, Mich. He brings to his new position a background of more than twenty years of association with the silent and roller chain industry.

HAROLD M. LOCHRANE has recently joined the Kaydon Engineering Corporation, Muskegon, Mich., manufacturer of special ball and roller bearings, fittings, and ordnance parts. He will be in charge of methods and standards.

G. L. LECKNER and E. J. MCKENZIE, of the Renkcel Engineering & Pyrometer Service Co., have been appointed district engineers in the state of Michigan for the Despatch Oven Co., Minneapolis, Minn.

New England

J. E. STRACHAN, JR., who has been representing the Norton Co., Worcester, Mass., in the Cincinnati territory, has been assigned to the Pacific Northwest to replace A. M. PITTS. S. F. PRESCOTT, of the Worcester sales engineering department, has become salesman in the Cincinnati territory. J. P. ENRIGHT, formerly a member of the Chicago office staff, has been made field engineer for the Chicago district. WENDELL C. FORSMAN, of the sales engineering department at Worcester, has been appointed field engineer for Detroit and vicinity.

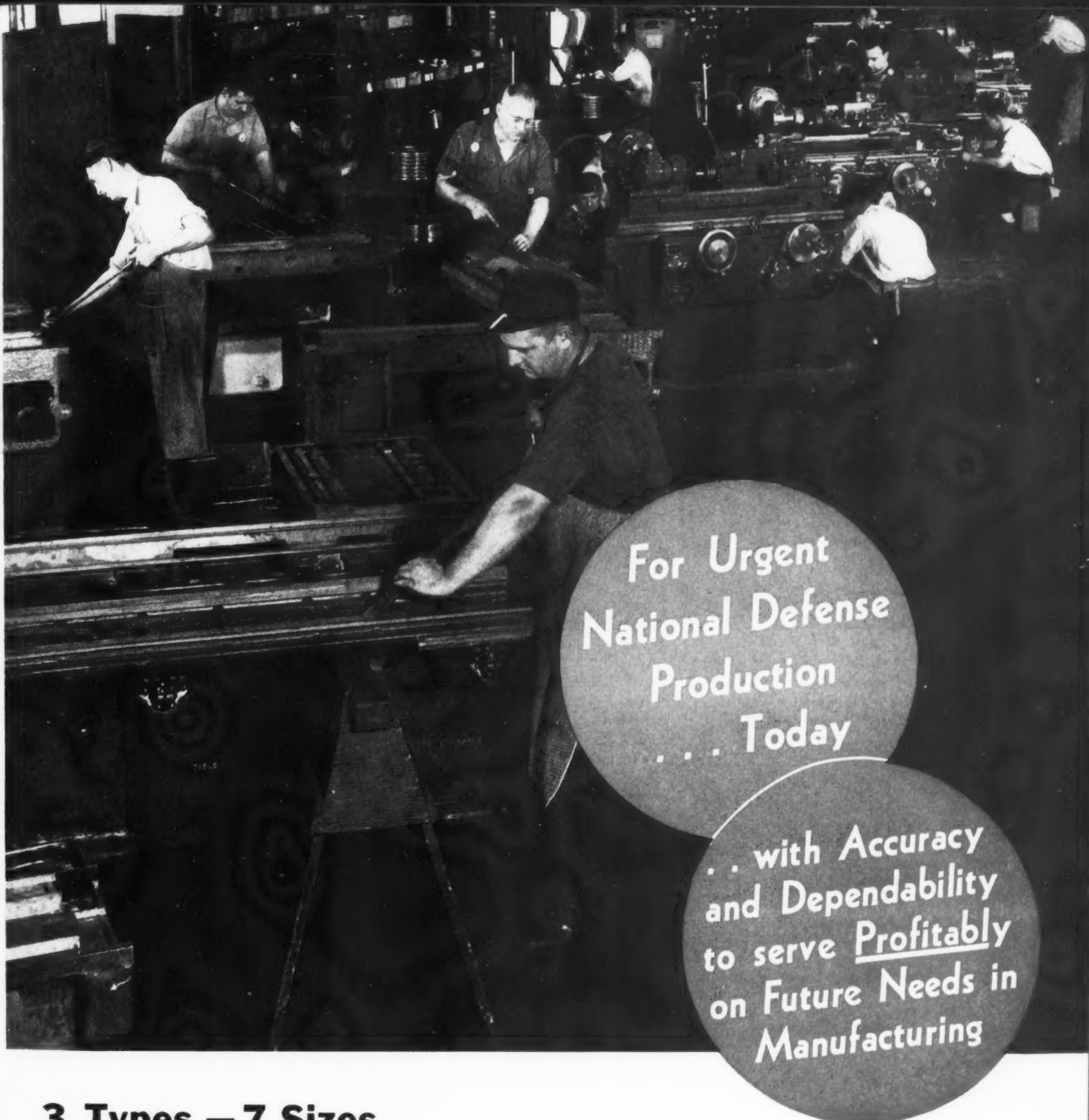
NORMAN J. VILE, who recently resigned as works manager of the Corbin Cabinet Lock Division of the American Hardware Corporation, has become connected with the Union Mfg. Co., New Britain, Conn., manufacturer of chucks, hoists, overhead trolleys, etc. Mr. Vile will devote his time to special problems.

E. B. GALLAHER, of the Clover Mfg. Co., Norwalk, Conn., gave an address before the General Motors Institute, Flint, Mich., November 12, on the subject "Coated Abrasives," treating of the latest developments in coated abrasive manufacture.

DUDLEY H. SMITH has been appointed general sales manager of Clark Bros. Bolt Co., Milldale, Conn. He was formerly district sales manager in charge of the company's Chicago office.

WILLIAM H. MILTON, JR., has been appointed manager of the plastics department of the General Electric Co. at Pittsfield, Mass., succeeding G. H. SHILL, who becomes assistant to the manager of the appliances and merchandise department, with headquarters in Bridgeport, Conn. Mr. Milton will have the responsibility for the operation of the company's five plastic factories in Pittsfield, Taunton, and Lynn, Mass., and in Fort Wayne, Ind., and Meriden, Conn.

William H. Milton, Jr., Manager of Plastics Department, General Electric Co.



3 Types — 7 Sizes

No. 5–3″ x 12″ and 3″ x 18″
Recessed base design

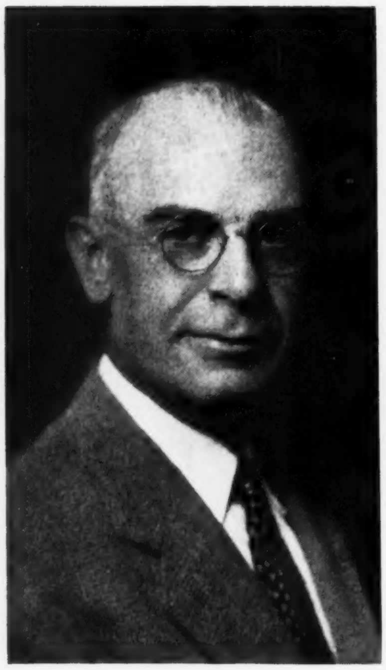
No. 10–6″ x 18″ and No. 12–6″ x 30″
Electric-Hydraulic Type

No. 20–10″ x 18″, No. 22–10″ x 36″
and No. 23–10″ x 48″
Electrically Controlled

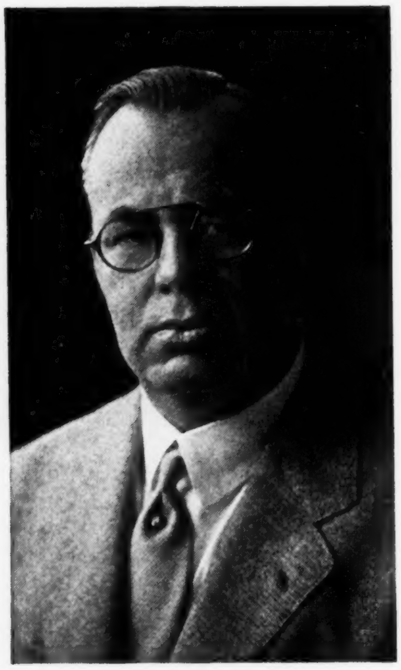
Specifications on request — showing their many features for *Better* and *Faster* Production.

BROWN & SHARPE MFG. CO.
Providence, R. I., U. S. A.

SHARPE



H. D. Tanner, Vice-president and Assistant General Manager of Pratt & Whitney Division Niles-Bement-Pond Co.



A. H. d'Arcambal, Recently Elected a Vice-president of Pratt & Whitney Division Niles-Bement-Pond Co.

William P. Kirk, Recently Elected a Vice-president of Pratt & Whitney Division Niles-Bement-Pond Co.

H. D. Tanner, vice-president and manager of the Machinery Division of Pratt & Whitney Division Niles-Bement-Pond Co., West Hartford, Conn., has been made vice-president and assistant general manager. A. H. d'Arcambal, sales manager of the Small Tool and Gage Divisions, and consulting metallurgist, has been elected a vice-president. William P. Kirk, sales manager of the Machinery Department, has also been made a vice-president. Both Mr. d'Arcambal and Mr. Kirk will retain their previous duties.

New York

J. K. Findley, of the Metallurgical Department of the Allegheny Ludlum Steel Corporation, Dunkirk, N. Y., recently addressed the Philadelphia Chapter of the American Society for Metals on the subject of "Die Steel." G. M. Butler, of the same corporation, made an address on "Stainless Steel."

William H. Bennett, representative in western New York State for the line of small tools made by the Brown & Sharpe Mfg. Co., Providence, R. I., and later connected with Brown & Sharpe of New York, Inc., retired October 1, after forty-three years' service.

J. F. Eckel has been appointed supervisor of the subcontracting program of the General Electric Co., Schenectady, N. Y.

Ohio

H. T. Florence has been made vice-president of the Cleveland Crane & Engineering Co., Wickliffe, Ohio. He will continue to serve also in his present capacity of general manager. Mr. Florence has served the company for twenty years. W. C. Sayle has been elected president to succeed his father, the late W. D. Sayle, who founded the company in 1897.

H. T. Florence, New Vice-president of Cleveland Crane & Engineering Co.

Denison Engineering Co., 119 W. Chestnut St., Columbus, Ohio, has purchased a 26-acre plot of land on the outskirts of Columbus on which will be erected a new plant which will provide 50,000 square feet of floor space. With the additional space, the company will employ approximately three hundred more people. Operation will be continued in the present plants at 119 W. Chestnut St., 302 N. Ludlow St. and 548 W. Broad St. The company is now producing defense equipment on direct government contracts, including shell loading presses, testing equipment for airplane spark plugs, oil hydraulic systems, crankshafts, brakes, gun recoil, and presses for assembling shells.

Reed-Prentice Corporation, Worcester, Mass., has established an office in the Penton Bldg., 1213 W. 3rd St., Cleveland, Ohio. A. R. Morse will have charge of the Cleveland office and of the servicing in that territory of the Reed-Prentice line of lathes, milling machines, die-sinking machines, jig-boring machines, plastic molding machines, and die-casting machines.

Albert Wartinger has been appointed chief engineer of the Sheffield Corporation, Dayton, Ohio, and Fay Aller has been made director of research. Mr. Wartinger was previously chief engineer of the Tool and Die Division, and Mr. Aller was chief engineer of the Gage and Machine Tool Division.

C. A. HEIL, district sales manager for the Carpenter Steel Co. at Cleveland, Ohio, has retired after thirty-two years of service with the company, and has been succeeded by JAMES S. BAILEY, JR., who has been on the Cleveland sales staff for the last thirteen years.

W. J. SAMPSON, JR., has been appointed general manager of sales of the Steel and Tubes Division of the Republic Steel Corporation, Cleveland, Ohio, succeeding L. W. HARSTON.

LEES-BRADNER Co., Cleveland, Ohio, has moved into a new plant at W. 121st St. and Elmwood Ave.

Pennsylvania and Maryland

JESSOP STEEL CO., Washington, Pa., recently gave a testimonial dinner to seventeen employes who have been associated with the company for twenty-five years or more. F. T. H. Youngman, first vice-president, R. J. Murray, secretary, and H. Wilson, Jr., vice-president in charge of operations, extended greetings to the men. The seventeen men who attended the dinner, together with J. Switzer, who was unable to attend on account of illness, have served a total of 558 years, their terms of service ranging from twenty-five to fifty-five years. The oldest employe, R. Brown, was with the parent Jessop company in Sheffield, England.

Harry Wilson, Jr., Vice-president in Charge of Operations, Jessop Steel Co.

HARRY WILSON, JR., works manager of the Jessop Steel Co., Washington, Pa., has been made vice-president in charge of operations. Mr. Wilson is the fifth generation of the Wilson family to work for the Jessop Steel Co., members of the family having worked continuously for the company since 1774. R. J. MURRAY, secretary of the company, has also been elected assistant treasurer.

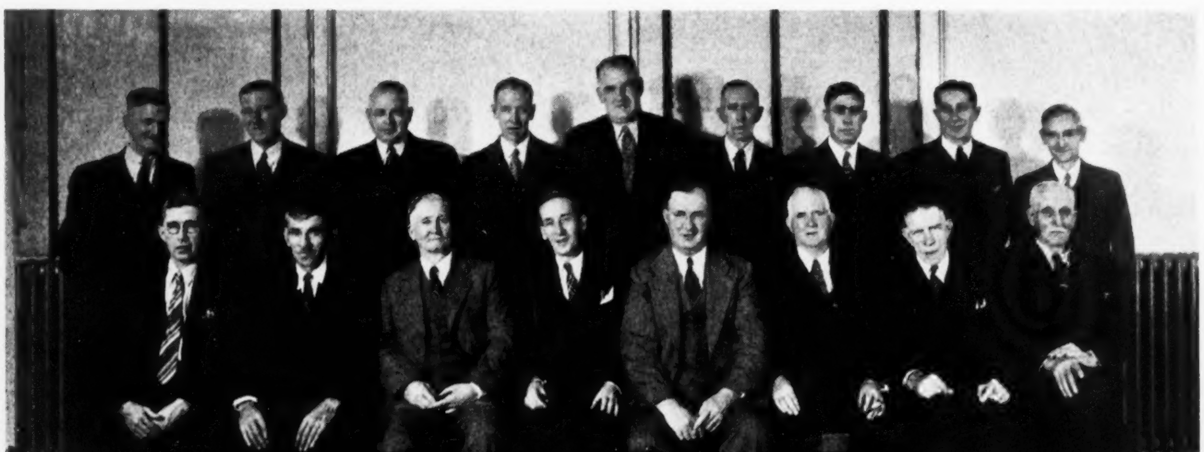
JESSE H. LIDE has been appointed assistant general advertising manager of the Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa. His headquarters will be at the company's Pittsburgh office. Mr. Lide was previously assistant advertising manager of the Merchandising Division of the company in Mansfield, Ohio.

REVERE COPPER & BRASS, INC., 230 Park Ave., New York City, is building a new mill at Baltimore, Md., under the auspices of the Defense Plant Corporation for manufacturing condenser tubes for the United States Navy and the United States Maritime Commission. The total floor area will be over 170,000 square feet.

* * *

South Africa Symbolizes Welding on Stamps

The important part that arc welding is playing in the war effort has been recognized by the Union of South Africa in issuing a postage stamp depicting a welder using modern shielded electric arc equipment. This is a 6-penny (12-cent) stamp. The Lincoln Electric Co., Cleveland, Ohio, from whom this information was obtained, mentions that, to the best knowledge of the company's officials, this is the first time that welding has been symbolized on a postage stamp.



Group of Employes Who have been Connected with the Jessop Steel Co. for Twenty-five Years or More. Top Row, Left to Right: H. G. Steed, 25 years; G. Yoders, 25 years; R. Haas, 26 years; L. Behner, 25 years; J. Wilson, 31 years; R. Mosier, 37 years; D. Marra, 26 years; W. Rush, 25 years; E. Anderson, 25 years. Bottom Row, Left to Right: D. Durbin, 25 years; E. Maglee, 25 years; J. McBride, 36 years; A. R. Anderson, 38 years; H. Wilson, Jr., 36 years; R. Brown, 55 years; E. King, 39 years; H. Whiteman, 30 years.


CINCINNATI BICKFORD DEFENSE ACCOMPLISHMENTS . . .
. . . this battery of
SUPER SERVICE RADIALS
is speeding Warner & Swasey
Turret Lathe Production!
CINCINNATI
BICKFORD
• It takes machine tools to make machine tools . . . and here in the plant of Warner & Swasey, it's a battery of Cincinnati Bickford Super Service Radials helping to turn out W & S Turret Lathes in an ever increasing stream. To bring defense production to a peak, Warner & Swasey is working 24 hours a day, 7 days a week . . . and these Super Service Radials are on the job all the time, and doing a job all the time!
On this particular unit, the job consists of drilling, reaming and finish boring of a W & S multiple turning head casting . . . the hole is 2½" in diameter . . . four holes are completed, plus a chamfer operation, before the piece leaves this machine.
Here, then, is another phase of Cincinnati Bickford's all-out effort in behalf of defense. Like all other machine tool manufacturers, Cincinnati Bickford realizes its responsibility . . . hand in hand cooperation is the watchword. Wherever rapid, low cost, high precision and quality work is demanded, there you'll find Cincinnati Bickford Super Service Radials, serving in a saving and satisfactory way.
SUPER CB SERVICE
THE CINCINNATI BICKFORD TOOL CO.
OAKLEY · CINCINNATI · OHIO · U. S. A.

OBITUARIES

Clifford S. Stilwell

Clifford S. Stilwell, executive vice-president of the Warner & Swasey Co., Cleveland, Ohio, died suddenly of a heart attack on November 19 at the St. Luke's Hospital in Cleveland. Mr. Stilwell was born in Freehold, N. J., in 1890. His family moved to Cleveland in 1903, when his father, Herbert F. Stilwell, became pastor of the First Baptist Church.

Mr. Stilwell attended the Central High School and graduated from Denison University in 1912. Immediately after graduation, he entered the Warner & Swasey Co. as a special apprentice. He became manager of the company's Detroit office in 1914, general sales manager in 1930, and vice-president in 1935.

Photo Greystone Studios

Clifford S. Stilwell

Mr. Stilwell was well known throughout the machine tool industry, and just last month was elected president of the National Machine Tool Builders' Association. He had served as a trustee of Denison University since 1935, and in April of this year was elected chairman of the board of trustees. Mr. Stilwell was elected president of the University Club of Cleveland last April. He was a trustee of the First Baptist Church of Cleveland and a member of the Union Club, the Cleveland Chamber of Commerce, and the Cleveland Engineering Society.

He is survived by his wife, a son, a daughter, and his brother, Charles J. Stilwell, president of the Warner & Swasey Co.

August P. Munning

August P. Munning

August P. Munning, an outstanding figure in the electroplating industry of America, died on October 29 at the home of his daughter in Matawan, N. J., after several months' illness, at the age of sixty-eight years. Mr. Munning was born in Chicago on March 8, 1873. He entered the electrical industry in 1888, first becoming connected with the Leonard Izard Co., which was then agent for the original Edison Co. Later he joined the Cutler-Hammer Mfg. Co., rising to the post of general sales manager.

In 1911, Mr. Munning entered the electroplating equipment and supply business, organizing the Munning Loeb Co. in Matawan. This firm was merged in 1918 with the George Zucker Co. of Newark under the name A. P. Munning & Co., and Mr. Munning became president of the new concern. In 1927, the latter company was merged with the Hanson & Van Winkle Co. to form the Hanson-Van Winkle-Munning Co. Mr. Munning was made chairman of the board of this concern, and retained this position until his retirement in 1935. A few years later he again became active in the company as a member of the executive committee. In 1940, he retired to become president of the Matawan Bank, in which position he continued until his recent illness.

Mr. Munning was internationally known for his accomplishments in the electroplating industry. He was an Edison Pioneer. He was a strong supporter of the American Electroplaters' Society and an ardent believer in raising the standards of the industry.

Mr. Munning is survived by his mother, Mrs. August A. Munning, of Chicago, his widow, a daughter, Mrs. John A. Bauer, four brothers, and a sister, Mrs. Charles Thelen.

Ford R. Lamb

Ford R. Lamb, executive secretary and past-president of the American Society of Tool Engineers, died at his home in Pinckney, Mich., on October 26, aged fifty years. Mr. Lamb was born in Williamstown County, Mich., on June 28, 1891. He attended the Perry, Mich., High School and the Lansing Business University, and also took various extension courses at the Cass Technical High School. In 1920, he joined the Studebaker Corporation, gradually working his way up to assistant production engineer. While in the methods and standards department of the Studebaker organization, he acted as apprentice instructor, in which capacity the seed of what later was to become his life's work first germinated.

Mr. Lamb left the Studebaker Corporation to join the Detroit College of Applied Science as instructor in tool design and treasurer. Subsequently he became connected with the Consolidated Machine Tool Corporation in the capacity of sales engineer, with which concern he was associated for nine years. While connected with the Detroit College of Applied Science, Mr. Lamb became acquainted with O. B. Jones, who in 1931 had started at the Detroit College a society of tool engineers, composed mainly of students of tool engineering. In 1932, Mr. Jones conceived the idea of creating a national society of tool engineers and Mr. Lamb enthusiastically collaborated with him.

The American Society of Tool Engineers soon became the life interest of Ford Lamb. He was a member of

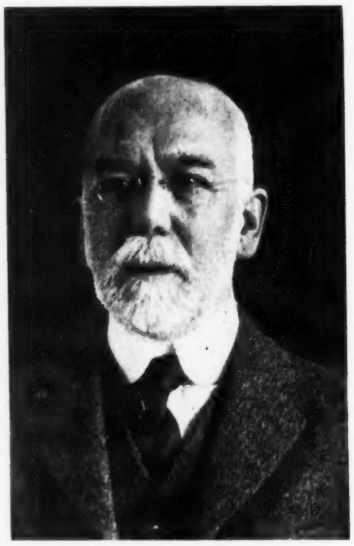
Ford R. Lamb


1942
... A GOOD YEAR TO BUY *Precision* MACHINES!
New requirements indicate that production still has a long way to go —that 1942 will be a year of much greater need for *the right kind of machines* if the vast quantities of defense materials now demanded are to be realized without sacrifice of accuracy. . . . Wherever production calls for precision boring, turning, facing, lapping, and accurately finished threaded work, a machine tool bearing the name of Ex-Cell-O, pioneer in precision machining, is *exactly the right equipment*. . . . This is why standard Ex-Cell-O Precision Machines are in the forefront throughout American industry—why many prime and sub-contractors, getting into full swing on defense work, are selecting Ex-Cell-O precision machine tools as an assurance of maximum production, accuracy, and economy in 1942.
EX-CELL-O CORPORATION • DETROIT, MICH.
EX-CELL-O
XLO
Precision THREAD GRINDING, BORING AND LAPPING MACHINES, TOOL GRINDERS, HYDRAULIC POWER UNITS, GRINDING SPINDLES, BROACHES, CUTTING TOOLS, DRILL JIG BUSHINGS, PARTS

the first board of directors, and in 1936 was elected president of the Society. When his term of office expired in 1937, he became executive secretary, which position he held until the time of his death. Under his direction, the Society grew from a small struggling organization with fourteen chapters to an important national society having forty-two chapters and over 8000 members. The Machine and Tool Progress Expositions which the Society started in 1938 have attracted nation-wide attention. One of the objectives of the Society that Mr. Lamb had worked hard to obtain was the organizing of special courses in tool engineering at high schools and universities. Mr. Lamb is survived by his wife and five children.

Henry Newton

Henry Newton, who retired from the Brown & Sharpe Mfg. Co. at the close of 1937, after forty-eight years of service, died suddenly on October 30 at Providence, R. I., in his seventy-seventh year. In addition to having served in the advertising and small



Henry Newton

tool departments of the Brown & Sharpe organization, he had charge for a number of years of foundry sales, and was particularly identified with the representation of the company in connection with the manufacture of Willcox & Gibbs sewing machines.

Paul F. Reichhelm

Paul F. Reichhelm, president of the American Swiss File & Tool Co., Elizabeth, N. J., died on October 3 after a long illness. Mr. Reichhelm had been associated with the American Swiss File & Tool Co. ever since it was founded by his father, E. P. Reichhelm, in 1900. He succeeded his father as president in 1916. Mr. Reichhelm, in continuing the work of his father, built the company up to the position of the largest exclusive manufacturer of Swiss pattern files in the United States. He developed many special processes for improving the manufacturing methods used in producing this type of file, on which he was an acknowledged authority. Mr. Reichhelm is survived by his widow and a brother. The business will be continued under the direction of Frank E. Shurts and R. D. Macdonald, who have been connected with the organization for many years.

Paul F. Reichhelm

WILLIAM O. STEEL, New York representative for the Carpenter Steel Co., Reading, Pa., died suddenly on November 4. He joined the company thirty years ago in the New England territory, and became associated with the New York office in 1912.

* * *

Annual Meeting of Meehanite Institute

Nearly one hundred members of the Meehanite Research Institute of America, Inc., 311 Ross St., Pittsburgh, Pa., attended the thirteenth annual meeting of the Institute at Cleveland, Ohio, November 6 to 8. About thirty-five research papers pertaining to recent developments in foundry and metallurgical practice were presented. Many of these dealt with recent problems created by the Defense Program.

The following officers were elected for 1942: President, Oliver Smalley, president, Meehanite Metal Corporation, Pittsburgh, Pa.; vice-president, H. B. Hanley, American Laundry Machinery Co., Rochester, N. Y.; secretary-treasurer, Frank M. Robbins, president, Ross-Meehan Foundries, Chattanooga, Tenn.

COMING EVENTS

DECEMBER 1-5 — Annual meeting of the AMERICAN SOCIETY OF MECHANICAL ENGINEERS at the Hotel Astor, New York City. C. E. Davies, secretary, 29 W. 39th St., New York City.

JANUARY 12-16, 1942 — Annual meeting of the SOCIETY OF AUTOMOTIVE ENGINEERS at the Book Cadillac Hotel, Detroit, Mich. John A. C. Warner, secretary and general manager, 29 W. 39th St., New York City.

MARCH 12-14, 1942—Annual meeting of the AMERICAN SOCIETY OF TOOL ENGINEERS in St. Louis, Mo. Clyde L. Hause, secretary, 2567 W. Grand Blvd., Detroit, Mich.

MARCH 23-25, 1942—Spring meeting of the AMERICAN SOCIETY OF MECHANICAL ENGINEERS in Houston, Tex. Secretary, C. E. Davies, 29 W. 39th St., New York.

JUNE 8-10, 1942—Semi-annual meeting of AMERICAN SOCIETY OF MECHANICAL ENGINEERS in Cleveland, Ohio.

* * *

Monarch Machine Tool Co. Receives Navy "E" Pennant

On November 11, the Monarch Machine Tool Co. was presented with the U. S. Navy Bureau of Ordnance Flag and the Navy "E" pennant. The presentation was made by Admiral William Harrison Standley at the Monarch plant. This pennant is presented by the Navy for outstanding effort in the production of ordnance materials for the Navy. The 1500 men now employed on the day and night shifts at the Monarch plant attended the presentation ceremonies.

In a letter advising W. E. Whipp, president of the Monarch Machine Tool Co., of this award, Frank Knox, Secretary of the Department of the Navy, wrote as follows: "It gives me pleasure to advise you that your company has been chosen to receive the Flag of the Bureau of Ordnance, Navy Department, and the Navy "E" pennant as a recognition of outstanding effort in the production of ordnance materials vital to national defense. Your company will have the privilege of flying this flag and pennant as a public evidence of deserved honor and distinction. In addition, your employes will be entitled to wear a special lapel button bearing the name of the company, the insignia of the Bureau of Ordnance, and the Navy "E," which is a traditional Navy award."

NEW BOOKS AND PUBLICATIONS

TOOL DESIGN. By Charles Bradford Cole. 498 pages, 6 by 9 inches; 425 illustrations. Published by the American Technical Society, Chicago, Ill. Price, $4.50.

This book on tool design has been prepared by a man having a detailed knowledge of the subject dealt with. Mr. Cole is president of the Tool Equipment Sales Co., of Chicago, Ill., and also practices as a consulting mechanical engineer. He is a member of the American Society of Mechanical Engineers and of the American Society of Tool Engineers, and, hence, has a background that makes him well equipped for the preparation of a book of this kind. Probably the most comprehensive conception of the contents might be given by listing the principal sections of the book: Practice and procedure in tool design; materials for making tools; jig, fixture, and tool design standards; commercial standards for tool design; cutting tools; tooling for production; drill jigs; fixtures; dies; and gages. The book is profusely illustrated, most of the illustrations being line drawings—reproductions of actual working drawings. In one sense, this book is a companion to the book "Toolmaking" formerly published by the same author. The book should be useful to the great number of young men, who, due to the present conditions, are being trained for tool designing. It will also prove a valuable source of reference to the more experienced men.

EFFECTIVE FOREMANSHIP. Edited by Harold B. Maynard. 263 pages, 6 by 9 inches. Published by the McGraw-Hill Book Co., Inc., 330 W. 42nd St., New York City. Price, $2.50.

This manual on foremanship practice and technique is the result of the collaboration of fifteen experts, each of whom has handled a different subject. The aim is to guide the foreman who is just assuming his new responsibilities, as well as to help the experienced foreman who wants to improve his abilities. The book explains the fundamental principles, gives actual examples of their application, and deals with the everyday problems encountered by the foreman, placing particular emphasis on common-sense methods of solving them.

The subjects treated in the nineteen chapters are as follows: Responsibility of Foremanship; Industrial Economics; Industrial Organization; Complexity of Modern Foremanship; Importance of Planning the Effective Use of Tools and Facilities; Human Element in Industrial Relations; Value of Knowing Materials and Products; Effective Working Methods; Operator Training; Control of Production through Time Standards; Wage-Payment Problems; Production Planning and Scheduling; Quality Control; Cost Control; Maintaining a Safe Department; Promoting Improvements; Effect of Orderliness on Production; Waste Control; and Applying the Principles of Modern Foremanship.

HANDBOOK OF SLEEVE BEARINGS. By Albert B. Willi. 220 pages, 6 by 9 inches. Published by the Federal-Mogul Corporation, Shoemaker and Lillibridge Sts., Detroit, Mich.

This handbook on sleeve bearings, which is the result of years of specialization in this field, is written by the chief engineer of the Federal-Mogul Corporation to serve as a practical guide for the engineer, designer, and draftsman in the selection, design, and application of sleeve bearings and bushings, both plain and flanged, full-round and split. It discusses the effect of design, alloys, and manufacturing methods on sleeve-bearing efficiency, and defines the field of application for all the basic types of sleeve bearings. One section of the book lists the sizes and types of bearings and bushings for which major manufacturing tools are now available.

The material is divided into eleven sections dealing with materials of bearing construction; the precision insert split bearing; oil-grooving; special types of split sleeve bearings; shims for adjustment of bearing clearance; and dimension sheets for various styles of bearings. Copies of this book are available to those directly concerned with sleeve-bearing installations by application to the corporation.

MACRAE'S BLUE BOOK (1941-1942). 3728 pages, 8 by 11 inches. Published by MacRae's Blue Book Co., 18 E. Huron St., Chicago, Ill. Price, $15.

This is the forty-ninth annual edition of a comprehensive buying guide covering all classes of manufactured products in the United States. This well-known directory follows the same arrangement in this edition as in previous ones, consisting of five principal sections. It contains an alphabetical list of the manufacturers represented in the classified material section, together with their addresses, and in some cases, names of local distributors. This section is followed by an alphabetical index to the products in the classified section. The classified material section, covering 2632 pages, contains a complete list of manufactured products alphabetically arranged, together with the names and addresses of the manufacturers. The trade facilities section gives the names of the leading commercial bodies, banks, railroads, and storage and distributing warehouses in all towns having a population of one thousand or more. The final section of the book contains an alphabetical list of the trade names of the various products and their manufacturers. The scope of this book makes it a great aid to purchasing agents and others who wish to locate sources of supply, as well as to those who may have to make up lists of manufacturers or products for various purposes. It is also of value in determining the addresses of manufacturers and the names of manufacturers of products known only by their trade names.

FATIGUE OF METALS—SOME FACTS FOR THE DESIGNING ENGINEER. 45 pages, 6 by 9 inches. Distributed without charge by the Nitralloy Corporation, 230 Park Ave., New York.

* * *

Carbide Tools Save Time in Machining Manganese-Steel Wheels

Manganese-steel railroad turntable wheels having a hardness of 550 Brinell are now being machined with carbide tools instead of being ground in the plant of Stearns-Stafford, Inc., Lawton, Mich. The result has been a 50 per cent decrease in production time. Up to the time that carbide tools were applied to the job, it had been found impossible to produce these wheels by any other method than grinding.

In machining these cast wheels, which range from 14 to 20 inches in diameter, Carboloy 883 (tungsten-carbide) type tools are used rather than the more usual 78B (tantalum-titanium) type designed for steel cutting. One reason for this is the higher abrasion resistance of the straight tungsten-carbides, compared with tantalum- and titanium-tungsten carbides.

In turning the wheel, a light cut, approximately 1/16 inch deep, with a 0.020-inch feed, is first taken to remove the pitted surface material and to take care of casting run-out. Following this operation, a deeper cut is taken. A relatively low cutting speed —around 45 feet per minute—is used to avoid possible shock breakage, due to hard spots and surface pitting.

Automatic Welding Gantry for Making Long Continuous Welds

An automatic welding gantry for making continuous welds of from 1 to 120 feet in length has been designed and built by the Cleveland Crane & Engineering Co., 1157 E. 283rd St., Wickliffe, Ohio, and recently installed in the structural department of this company's plant. The new gantry, shown in the accompanying illustration, has many features that make possible better welds, easier operation, and improved working conditions for the operators.

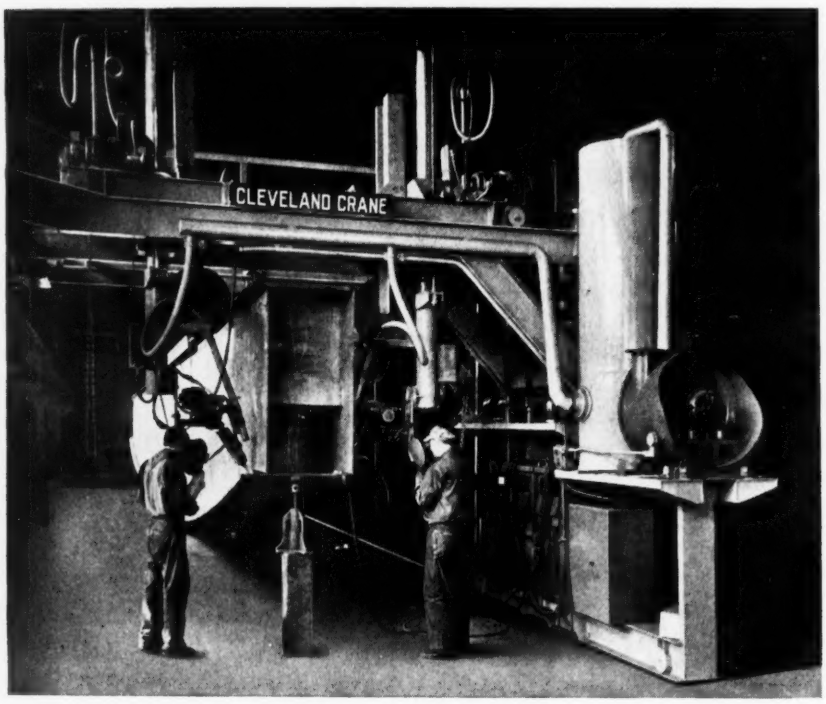
The machine can be traversed at any speed from 30 to 148 feet per hour to suit various sizes of welds and materials. As the gantry travels, the welding rod is fed precisely and automatically to both sides of the work. The tape in the welding heads is wrapped around the rod to shield the arcs. By welding both sides of the work at the same time, the welding heat is distributed evenly, thus neutralizing stresses and minimizing distortion. The use of this method enables straight accurate girders to be produced.

The welding heads are raised or lowered by individual push-button controlled motorized drives mounted on separate hand-propelled trolleys, which can be adjusted to suit the width of the work. A motor-generator set for actuating the welding arcs is located on a platform in the leg of the gantry. Two welding transformers and their controls, with switches and meters, are also located on the platform. An air-filtering unit mounted on the machine leg removes the welding smoke by means of suction nozzles at the welding heads.

Provision is made for easily connecting hand-welding equipment to make use of the welding transformers during periods when there is no work requiring automatic welding or for applications where hand-welding is desirable. The gantry is of rigid, all-welded steel construction and is provided with roller bearings throughout. It travels on two rails, one located on the wall and the other set in the floor. The traversing motor drives wheels on both rails, and thus assures even, straight-line travel.

* * *

In a modern 13-ton tank, there are 14,318 individual pieces. Many of these are duplicates; but there are, in one tank, 2865 parts that are all different from each other.



Welding Gantry Built by Cleveland Crane & Engineering Co., for Making Continuous Welds up to 120 Feet in Length

Motion Pictures on Lathe Operation

To speed up the training of lathe operators for national defense industries, the South Bend Lathe Works has prepared a series of 16-millimeter sound motion pictures in color. The films have been made by Burton Holmes Films, Inc., and have been produced at the South Bend lathe factory. The showing time for each of the two 800-foot reels now completed is approximately twenty minutes.

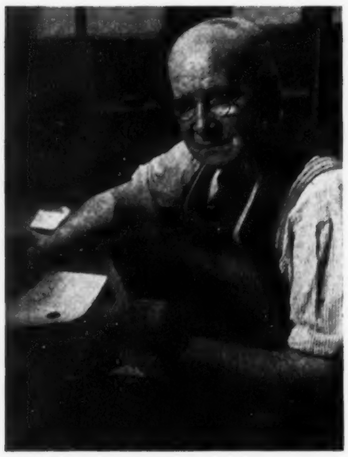
The first film is entitled "The Lathe." It shows the apprentice or prospective operator what a lathe is, what it is for, and how the various parts operate. Important lathe operations, such as turning, facing, and thread cutting, are demonstrated. The second reel, called "Plain Turning," shows in detail each operation performed in the machining of a straight cylindrical shaft held between centers. Close-up views show how to locate and drill the center holes, how to adjust and set the cutting tools, how to use cross-feed graduations, and also how to use calipers and micrometers, how to handle the quick-change gear-box, etc. Information on the use of these films by vocational schools or Army and Navy training schools can be obtained from the South Bend Lathe Works, Department M2, South Bend, Ind.

* * *

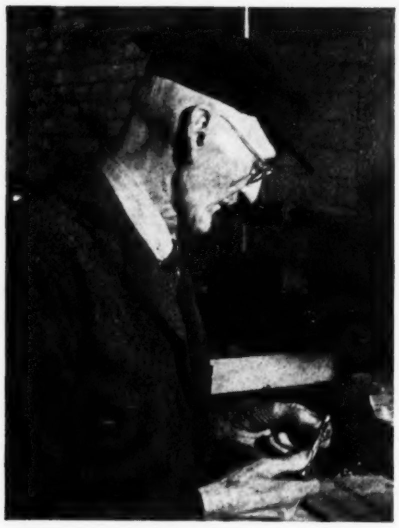
Educational Gage Charts

A portfolio of forty educational gage charts for use in colleges, universities, vocational and defense training schools, etc., has been prepared by the Sheffield Corporation, Dayton, Ohio. This collection of charts is entitled "Dimensional Control — Theory and Industrial Application." They are specifically prepared for the student to give him a conception of precision gaging in modern industry.

These charts cover basic definitions, such as tolerance, limit, clearance, interference, etc.; they also have illustrations of different types of gages, an explanation of unilateral and bilateral tolerances, tables of fits and tolerances, applications of gages, and an explanation of selective assembly and interchangeability.



Patrick Sullivan



Harry Kellogg

Thomas Collins, Sr.

The Man Over Forty Still Fills an Important Place in Industry

In view of the opinion so frequently expressed by men who, unfamiliar with industry and its methods, jump at conclusions, it is of interest to record three instances of men who have long since passed the year when "life began at forty," and who are still filling an important place in industrial production. Patrick Sullivan, one of the men whose picture is shown above, became connected with one of the predecessors of the Greenfield Tap & Die Corporation in 1889, and thus has completed fifty-two years of service with the company. Harry Kellogg made the first commercial "Greenfield" gage in 1910, and is still making gages today. Thomas Collins, Sr., who went to work for the company in 1887, now has fifty-four years of service to his credit.

* * *

Fully 65 per cent of the high-carbon chromium-steel bearings made by the New Departure Division of the General Motors Corporation at Bristol, Conn., are used for military purposes.

Rubber and Plastics to be Discussed by A.S.M.E.

Mechanical applications of rubber and plastics are among the important subjects to be discussed at the forthcoming annual meeting of the American Society of Mechanical Engineers at the Hotel Astor, New York City. The sessions dealing with these subjects will be held Thursday, December 4. Among the topics to be dealt with are "Practical Aspects of Vibration Isolation"; "Advances in Rubber and Plastics During 1941"; "Uses of Plastics in Aircraft Construction"; and "Influences of Molecular Structure on Properties of Plastics."

STATEMENT OF THE OWNERSHIP, MANAGEMENT, ETC., REQUIRED BY THE ACT OF CONGRESS OF AUGUST 24, 1912, of MACHINERY, published monthly at New York, N. Y., for October 1, 1941.

State of New York } ss.
County of New York }

Before me, a Notary Public in and for the state and county aforesaid, personally appeared Edgar A. Becker, who, having been duly sworn according to law, deposes and says that he is the treasurer of The Industrial Press, Publishers of MACHINERY, and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management, etc., of the aforesaid publication for the date shown in the above caption, required by the Act of August 24, 1912, embodied in section 411, Postal Laws and Regulations, printed on the reverse of this form, to wit:

1. That the names and addresses of the publisher, editor, managing editor, and business managers are: Publisher, The Industrial Press, 140-148 Lafayette St., New York; Editor, Erik Oberg, 140-148 Lafayette St., New York; Managing Editor, None; Business Managers, Robert B. Luchars, 140-148 Lafayette St., New York; Edgar A. Becker, 140-148 Lafayette St., New York; and Erik Oberg, 140-148 Lafayette St., New York.

2. That the owners of 1 per cent or more of the total amount of stock are: The Industrial Press, 140-148 Lafayette St., New York; Robert B. Luchars, 140-148 Lafayette St., New York; Erik Oberg, 140-148 Lafayette St., New York; Edgar A. Becker, 140-148 Lafayette St., New York; Laura A. Brownell, 140-148 Lafayette St., New York; Franklin D. Jones, 140-148 Lafayette St., New York; First National Bank & Trust Co. of Montclair and Robert B. Luchars, Trustees (Beneficiaries unknown), Upper Montclair, N. J.; First National Bank & Trust Co. of Montclair and Leigh Roy Urban, Trustees (Beneficiaries unknown), Upper Montclair, N. J.; First National Bank & Trust Co. of Montclair and Kenneth D. Ketchum, Trustees (Beneficiaries unknown), Upper Montclair, N. J.

3. That the known bondholders, mortgagees and other security holders are: Laura A. Brownell, 140-148 Lafayette St., New York; John Connolly, 140-148 Lafayette St., New York; Franklin D. Jones, 140-148 Lafayette St., New York; Robert B. Luchars, 140-148 Lafayette St., New York; Louis Pelletier, 140-148 Lafayette St., New York; Elizabeth Y. Urban, 163 Western Drive, Longmeadow, Mass.; Helen L. Ketchum, King St., Cohasset, Mass.; Wilbert A. Mitchell, 28 Harlow Road, Springfield, Vt., and Henry V. Oberg, 1317 Hill Crest Road, R. D. No. 1, Lancaster, Pa.

4. That the two paragraphs next above, giving the names of the owners, stockholders, and security holders, if any, contain not only the list of stockholders and security holders as they appear upon the books of the company, but also, in cases where the stockholder, or security holder, appears upon the books of the company as trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting, is given; also that the said two paragraphs contain statements embracing affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and securities in a capacity other than that of a bona fide owner; and this affiant has no reason to believe that any other person, association, or corporation has any interest direct or indirect in the said stock, bonds, or other securities than as so stated by him.

EDGAR A. BECKER, Treasurer

Sworn to and subscribed before me this 25th day of September, 1941

CHARLES P. ABEL
Notary Public, Kings County No. 313
(SEAL) Kings Register's No. 3109
New York County No. 231, New York Register's No. 3-A-161
(My commission expires March 30, 1943)